EVALUATION OF THE U.S. DEPARTMENT OF ENERGY MOTOR CHALLENGE PROGRAM

Prepared for:
Oak Ridge National Laboratory
Oak Ridge, Tennessee

Prepared by:
XENERGY, Inc.
Burlington, Massachusetts

Energy Efficiency and Renewable Energy
U.S. Department of Energy

Office of Industrial Technologies

Contents

Contents (continued)

Contents (concluded)

Executive Summary

E.1 Overview

This report presents an independent evaluation of the energy savings and market effects of the U.S. Department of Energy's Motor Challenge program. Development of the Motor Challenge (MC) was initiated in 1993, and the program was launched in the fall of 1995. The program is managed by the Office of Industrial Technologies (OIT) in partnership with U. S. industry. The primary objective of Motor Challenge is to increase the energy efficiency of motor-driven systems used in the manufacturing sector. In 1999, OIT consolidated a number of its technology deployment programs, including Motor Challenge, into BestPractices.

This evaluation estimates the energy savings associated with program activities and services delivered from its launch in 1995 through September 1999. Evaluation of the early accomplishments of Motor Challenge is relevant to BestPractices because the consolidated program has adopted many of the operating approaches of the original effort.

Program Description. Motor Challenge pursues its objectives through two kinds of basic program activities.

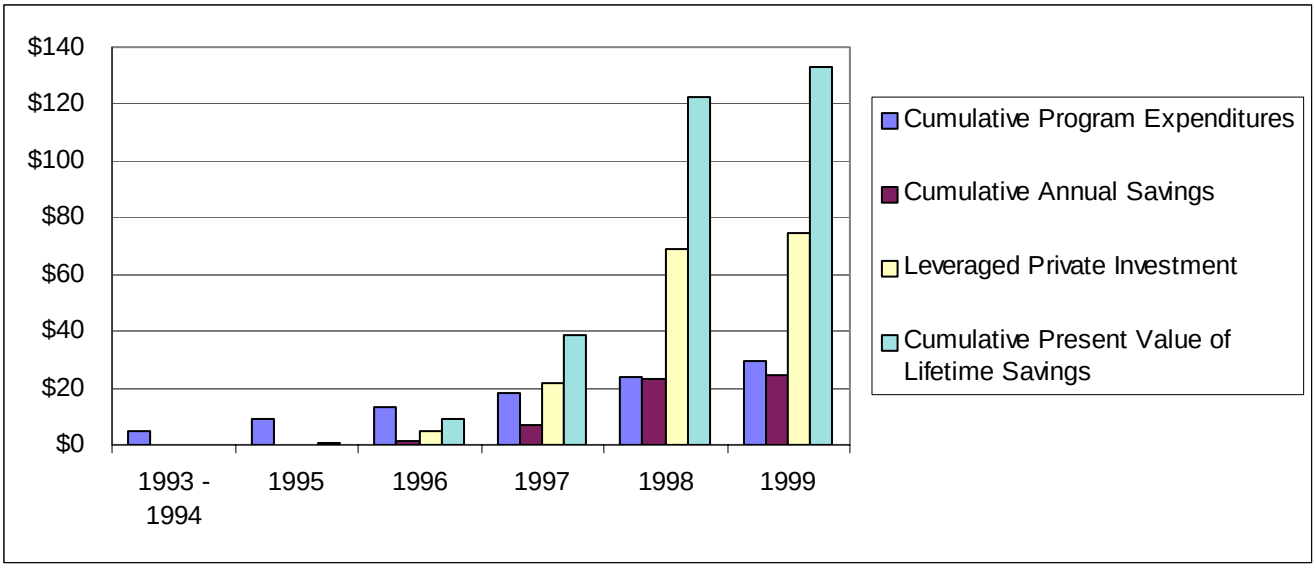
- ***Motor Systems Efficiency Tool Development and Dissemination.*** The Motor Challenge has developed a set of project planning and preventive maintenance tools designed to help facility managers, their vendors, and consultants identify and cost-justify specific actions to reduce energy use in their motor systems. The most well known of these tools is the MotorMaster+ motor selection and management software, which has been distributed to thousands of industrial end users, vendors, and consultants nationwide.
- ***Partnership Programs.*** The Motor Challenge works with many different kinds of organizations to ensure that program tools reach end users and vendors when they are making motor system purchase, management, and maintenance decisions. The *Allied Partner Program* serves roughly 200 organizations split evenly between vendors and program operators such as utilities, industry associations, and government agencies.

Key Evaluation Results. Using a variety of research and analysis methods, we found that:

- ***Information, motor management tools, and technical services delivered by the Motor Challenge program from inception through September 1999 encouraged and enabled industrial facility operators to reduce energy consumption by 520 GWh per year.*** These savings are valued at $24.9 million at current rates, with annual avoided air emissions of 130,000 metric tons of carbon equivalent per year.
- ***The program was highly cost effective.*** Total program expenditures from inception through September 1999 amounted to $29.2 million. Program activities stimulated nearly $75 million of private investment in energy efficiency improvements to industrial motor systems. The discounted present value of lifetime savings from improvements attributable to Motor Challenge amounted to over $132 million. That is over four times the amount of program expenditures from inception through September 1999.

  Figure E-1 shows cumulative program expenditures, leveraged private investments in efficient motor system equipment, annual energy savings attributable to the program, and the present value of those savings for each year in the period under evaluation.

Figure E-1
Key Cost and Benefit Outcomes of the Motor Challenge Program:
Program Inception - September 1999



E.2 Summary of Evaluation Methods and Results

The research questions addressed in this evaluation are as follows.

- How many end-user facilities, vendors, utilities, and government agencies received assistance from the program?
- To what extent did Motor Challenge participants adopt the "best practices" recommended and supported by the program's tools, informational materials, and training services?
- What portion of reported capital improvements and changes in motor system management practices were attributable to Motor Challenge?
- How much energy did changes in motor system practices attributable to the Motor Challenge program save?

XENERGY used a variety of research methods to develop the information needed to address the evaluation questions. These included analysis of program records, assessments of end users, vendors, and government officials who participated in the program, and application of motor system inventory information from the *U. S. Industrial Electric Motor Systems Market Opportunities Assessment* (*Market Assessment*)[1] to estimate energy savings. The key results of the evaluation are as follows.

E.2.1 Estimate of Energy Savings

The annual energy savings attributable to the program are estimated at 520 GWh per year; 4,163 GWh over the useful life of motor system efficiency measures implemented by participants as a result of their involvement with the program. Table E-1 shows the distribution of these energy savings attributable to different program components. Program components such as training for vendors in adjustable speed

[1] XENERGY Inc. (1998) *United States Industrial Electric Motor Systems Market Opportunities Assessment.* U. S. Department of Energy's Office of Industrial Technologies and Oak Ridge National Laboratories. See Section 1.2.1 of this report for more details and key findings.

drive applications and support for Allied Partners in their efforts to promote energy-efficient motor systems yielded particularly high savings, primarily due to their ability to reach large numbers of end users. Annual emission reductions associated with these energy savings equal 130,000 metric tons per year; 1,041,000 metric tons over the useful life of the measures.

E.2.2 Cost-Effectiveness

The Motor Challenge program has proven to be highly cost-effective in motivating and enabling customers to improve the energy efficiency of the motor systems they purchase, as well as supporting the specification and sale of energy-efficient motor systems by vendors and engineers. By any measure used to determine the cost-effectiveness of economic programs, Motor Challenge has been a major success, even when applying very conservative assumptions in the cost-effectiveness calculations.[2] We estimated the monetary value of energy savings attributable to the program at $24.9 million per year as of September 1999. The net present value of those energy savings over the useful life of the efficiency measures is estimated at over $132 million. To achieve these savings, industrial facilities operators who participated in the program spent an estimated $74.8 million. Over the 6 years of program operation covered by this evaluation, total program operating expenditures amounted to $29.2 million.
The key cost-effectiveness results for the program are as follows:

- For every dollar it spent over its first 6 years of planning and operation, the program leveraged $2.56 in private end-user investment in energy efficiency measures.
- Energy savings attributable to the program were 4.55 times greater than program expenditures.
- Even applying the rigorous cost-effectiveness standards used to evaluate utility programs, which count leveraged customer expenditures as a program cost, the program remains cost-effective.

Based on the analysis described above, we conclude that Motor Challenge has been *very* cost-effective, especially in comparison to utility-sponsored rebate programs designed to stimulate the market for efficient motors. Since the enactment of the 1997 Federal motor efficiency (EPAct) standards, such programs have experienced difficulties in meeting cost-effectiveness standards, due primarily to the relatively low unit savings available from upgrading motor efficiency from EPAct to so-called premium standards. One such program sponsored by utilities in the Northwest suspended operations due to problems in meeting cost-effectiveness criteria.

E.2.3 Breadth of Program Reach

Over the 6-year life of the program, Motor Challenge has established communication channels with technical and management decision-makers who represent a large portion of U.S. motor system purchases and energy consumption. As of September 1999, there were 5,655 *registered* MotorMaster+ users representing 3,664 unique end-user facilities. On average, the registered MotorMaster+ users are large industrial facilities. XENERGY estimated that they use roughly 20 times more motor system energy than the average manufacturing plant and 5 times as much as a typical utility-sponsored motor program participant. Altogether, we estimated that the population of registered MotorMaster+ users consumed 165,120 GWh/year in electricity versus 1.1 million GWh/year for industrial users as a whole. Thus, even though registered MotorMaster+ users represent less than 1 percent of all industrial facilities, they account for 15.2 percent of total industrial electricity use and a comparable portion of motor system energy.

---

[2] Net present value calculations assumed 8-year measure life. A 10 percent social discount rate was applied to projected annual savings. This is significantly greater than the 4 to 7 percent discount rates typically applied to social and economic programs and reflects the current high productivity of capital in manufacturing. Energy savings are valued at 4.8 cents per kWh, the average cost of electricity to industrial users in 1999. Cost savings associated with reduced demand charges are not included.

Table E-1
Summary of Motor Challenge Benefits, Costs, and Cost-Effectiveness

	Annual Program Benefits		Measure Lifetime Benefits	
Program Component	**MWh/Year**	**$ Savings/Year**	**MWh**	**NPV of Savings**
End users				
MotorMaster+	50,687	$2,432,971	405,495	$12,979,723
ASD Training	22,475	$1,078,779	179,797	$5,755,209
Pump Training	30,829	$1,479,797	246,633	$7,894,605
Showcase	24,148	$1,105,600	193,184	$5,898,296
Energy Matters	35,173	$1,688,305	281,384	$9,006,984
Teleconference	4,227	$202,912	33,819	$1,082,522
End users Subtotal	*167,539*	*$7,988,365*	*1,340,311*	*$42,617,339*
Allied Partners				
V & C	88,352	$4,240,872	706,812	$22,624,741
U & G	93,840	$4,504,340	750,723	$24,030,320
EASA	23,325	$1,119,594	186,599	$5,972,949
AFE	218	$10,460	1,743	$55,803
ASD Training	131,431	$6,308,695	1,051,449	$33,656,422
Pump Training	15,724	$754,744	125,791	$4,026,506
Non End users Subtotal	*352,890*	*$16,938,705*	*2,823,118*	*$90,366,741*
Total Energy Benefits	***520,429***	***$24,927,070***	***4,163,429***	***$132,984,080***
Program Costs				
Program Administration				$ 29,200,000
Customer Investments Energy Efficiency Measures				$ 74,781,211
Total Program Costs				***$ 103,981,211***
Benefit/Cost Tests				
Federal Benefit/Cost Ratio				***4.55***
Utility-type Program Cost Test				***1.28***

Therefore, at a minimum, Motor Challenge has identified technical and management personnel in 3,664 facilities that account for 15.2 percent of total industrial motor system energy use, or roughly 103,000 GWh per year. In addition to these end users, the program has identified potential decision makers in 2,000 to 4,000 facilities through its Information Clearinghouse and training activities. The customer identification records that support these operations are a key resource in advancing the mission of the program.

E.2.4 Extent of Potential Savings Captured in Participant Facilities

Participating end users captured a large portion of energy savings available from motor efficiency upgrades through actions attributable to the program—about 9 percent of the potential savings in their facilities. The evaluation found that many Motor Challenge participants are already following good practices in efficient motor purchase decisions. Still, among registered MotorMaster+ users interviewed for the evaluation, 18 percent reported that they implemented changes to motor system design, purchase, and maintenance practices that would not have been made in the absence of the program. Based on end-user reports of motor efficiency upgrades and replacement of motors that would otherwise have been

rewound, we estimated that MotorMaster+ registered users captured 9 percent of all potential savings available from those measures in their facilities.

Motor Challenge has barely scratched the surface in helping end users realize potential energy savings from system-level improvements, such as implementation new control strategies or optimization of compressed air system operations. Between MotorMaster+ users, training session attendees, and users of various information services, Motor Challenge has reached 6,000 to 8,000 end-user facilities directly. Using the results of the *Market Assessment* and the evaluation assessments, we estimate that these facilities used approximately 200,000 GWh per year in motor system energy. Our best estimate is that these facilities captured at most 323 GWh per year in system-level improvement savings, or 1.5 percent of the available potential.

This finding does not imply that Motor Challenge efforts to stimulate changes in end-user practices have been ineffective. On the contrary, we found that 24 percent of end users who participated in the ASD training program and 48 percent of those who participated in the Pump System training program reported that they implemented improvements to the efficiency of their systems that they would not have made in the absence of the program. Similarly, an assessment of end users who received the *Energy Matters* newsletter found that one-third reported that they had made changes in the way they purchased or managed motor systems as a result of reading the newsletter. Rather, the finding reflects the huge pool of energy savings available from system-level energy efficiency improvements.

E.2.5 Motor Challenge Impacts on the Supply Side of the Market

Allied Partners (vendors and consultants) who participated in the program reported that Motor Challenge tools were useful in convincing customers to purchase efficient motors and to implement other motor system efficiency measures. However, the Allied Partner reached relatively few firms using its early strategy of recruiting individual firms. More recent approaches to trade and industry associations are more likely to support broader dissemination and use of Motor Challenge tools on the supply side of the market.

- ***Recruitment results.*** As of September 1999, only 104 equipment vendors and consultants had been recruited as Allied Partners. By way of contrast, the structuring of a relationship with the Electrical Apparatus Service Association (EASA) created channels to over 1900 domestic motor dealer and service shops.
- ***Use of Motor Challenge tools or materials by vendors and consultants.*** Ninety percent of the interviewed vendor and consultant Allied Partners had used MotorMaster+ software. Of those who use MotorMaster+, 73 percent had used it to help customers with motor selection and 39 percent to assist them in replace v. repair decisions.

E.3 Lessons Learned and Conclusions

With 6 years of experience in developing the Motor Challenge program, there have been many valuable lessons learned.

- Motor Challenge has already established extensive and effective channels to personnel in end-user facilities and through a large number of key Allied Partner vendors. However, the majority of the potential savings in end-user facilities have not been achieved. The next major effort must be to develop a set of tools and materials that will support end users and vendors in achieving system-level savings.
- Program record keeping must be enhanced to enable managers and implementation staff to better characterize establishments quickly as to function (end-user v. vendor v. utility or trade association), industry, and size. This will aid in program marketing, client relations management, and evaluation.

- Leveraging the market is essential to maximizing the effect of any national market transformation program, such as Motor Challenge and now BestPractices for DOE. Suppliers must see motivational factors to joining and promoting an energy efficiency program. This win-win situation needs to be developed and leveraged.
- Tools need to be made simple and developed for decision-making at various stages of project implementation: general plant profiling, screening for technology opportunities, and implementation of projects. Consideration of time to be spent, or not spent, by different participants in energy efficiency project implementation should be respected when developing tools.
- Programs should develop activities for not only awareness and promotion, but also for implementation in partnership with industry on a plant level. More extensive resources are needed to assist Allied Partners to more easily convince and assist end users in project implementation.
- Working on a plant-by-plant basis to demonstrate the leading plants in implementing best management practices for motor-driven systems (motor, pumps, compressed air systems) will go a long way toward encouraging other companies to accelerate energy efficiency initiatives—industry has a tendency to follow leaders.

Section 1
Introduction

1.1 Program Overview

This report presents an independent evaluation of the impact of the United States Department of Energy's Motor Challenge program. The Motor Challenge (MC) was initiated in 1993. The program was developed and is managed by the Office of Industrial Technologies (OIT) in partnership with U. S. industry. The primary objective of Motor Challenge is to increase the energy efficiency of motor-driven systems used in the manufacturing sector. Motor Challenge pursues this objective through two kinds of basic program activities.

- ***Motor Systems Efficiency Tool Development and Dissemination.*** Working in cooperation with industry associations, academic institutions, and the national laboratories, the Motor Challenge has developed a set of project planning and preventive maintenance tools designed to help facility managers, their vendors, and consultants identify specific actions to reduce energy consumption in currently installed motor systems and quantify the costs and benefits of those measures. The most well known of these tools is the MotorMaster+ motor selection and management software. Over 23,000 copies of the program have been distributed to end users, vendors, consultants, utilities, and government agencies. Site assessment programs have also been developed for pump and compressed air systems. In addition to these computer-based tools, the Motor Challenge has developed a wide range of technical materials to support energy efficiency efforts. These include technical briefs, case studies, sourcebooks, and training manuals.

  The Motor Challenge has developed a number of channels by which to disseminate these materials. These include an information clearinghouse, a Web site, a newsletter, conferences, teleconferences, training workshops, and partnerships with a wide variety of organizations with links to end users and vendors.
- ***Partnership Programs.*** The Motor Challenge works with many different kinds of organizations to ensure that program tools reach end users and vendors when they are making motor system purchase, management, and maintenance decisions. The *Allied Partner Program* serves roughly 200 organizations, split evenly between vendors and consultants on one hand and utilities and government agencies on the other. In return for agreeing to promote the objectives of the Motor Challenge, Allied Partners receive Motor Challenge tools and materials in quantity at no or very low cost. They then distribute them directly to end users or use them in other ways to promote energy-efficient motor systems. For example, many utilities have used MotorMaster+ to support the design of rebate programs for energy-efficient motors.

  The Motor Challenge has developed customized partnerships with industry organizations that are designed to enhance the services those organizations provide to members while advancing the program's objectives. For example, the Technical Association of the Pulp and Paper Industry (TAPPI) has heavily advertised Motor Challenge materials and tools in its publications catalog and distributed over 400 copies of MotorMaster+ to pulp and paper mill plant engineers nationwide. The Hydraulic Institute has worked with the Motor Challenge to develop and distribute training materials on pump system efficiency.

The Office of Industrial Technologies administers the program, which contracts with a variety of organizations for tool development, operation of the Information Clearinghouse, and partnership program development.

1.2 Evaluation Objectives and Methods

1.2.1 Setting for the Evaluation

In 1996, OIT commissioned a study to characterize the inventory of motor systems in use in U.S. industrial facilities and to estimate the potential for energy savings in these systems. This study, *U.S. Industrial Electric Motor Systems Market Opportunities Assessment (Market Assessment)*[1], was based primarily on an on-site inventory of 265 industrial facilities, including a statistically representative sample of 254 *manufacturing* plants. The inventory collected detailed information on motor-driven systems in the sample facilities, including size, age, application, part-loads, and hours of use. This information was used to estimate motor system energy use disaggregated by industry (2-digit SIC category) and major application. The energy use estimates were then combined with information from a number of sources, including engineering analyses, panels of industry experts, and case study results, to estimate potential energy savings for key motor system efficiency measures. The inventory also collected information from plant managers on their practices in regard to purchase, management, and maintenance of motor-driven systems.

Among the key findings of the *Market Assessment* were the following.

- Industrial motor systems represent the largest single electrical end use in the American economy. In 1994, industrial electric motor systems used in production consumed over 679 billion kWh, or roughly 23 percent of all electricity sold in the United States.
- Potential industrial motor system energy savings using mature, proven, cost-effective technologies range from 11 percent to 18 percent of current annual usage, or 62 to 104 billion kWh per year, in the manufacturing sector alone. The mid-range estimate of potential savings is 14.8 percent of total current motor system energy use in the manufacturing sector.
- Motor system efficiency measures can be classified into two types: efficiency upgrades for individual components such as motors, pumps, or fans, and improvements in the design, configuration, and control of motor-driven *systems*, which consist of a motor, controls, and connected machinery that work together to perform a specific task. These *system level* improvements offer by far the largest portion of potential savings—71 percent of the total.
- Except in the largest facilities, the level of knowledge and implementation of systematic approaches to motor systems energy efficiency is low.
- Overcoming the barriers to adoption of efficient motor systems purchase and management practices will be difficult. These barriers include: conflicting priorities for capital investment, long capital replacement cycles, understaffing and inadequate training for plant maintenance and management divisions, and conflicting motivations among equipment suppliers.

The *Market Assessment* provided the market context, detailed baseline energy use estimates, and estimates of potential energy savings needed to assess the effects of the Motor Challenge.

[1] XENERGY Inc. (1998) *United States Industrial Electric Motor Systems Market Opportunities Assessment.* U. S. Department of Energy's Office of Industrial Technologies and Oak Ridge National Laboratories.

1.2.2 Evaluation Objectives

The primary objectives of this evaluation are to:

- Assess the effects of the Motor Challenge on the motor system purchase, management, and maintenance practices of end users who received tools, informational materials, or training services from the program.
- Assess the effects of the Motor Challenge program on the motor system specification and sales practices of vendors and consultants who received tools, informational materials, or training services from the program.
- Assess the effects of the Motor Challenge program on utilities and government agencies that used Motor Challenge tools and materials to plan or implement their own motor system efficiency programs.
- Develop a credible estimate of energy savings associated with improvements in motor systems with changes in end-user, vendor, and utility practices and programs attributable to Motor Challenge.
- Place the program accomplishments mentioned above in the context of the larger market for industrial motor systems.
- Identify initiatives that are likely to enhance program results.

1.2.3 Overview of Evaluation Methods

The evaluation research and analysis activities were designed to answer the following four questions.

- ***How many end-user facilities, vendors, utilities, and government agencies received materials, tools, and training services from the various Motor Challenge components? (How many establishments participated in the program?)*** To address this question, XENERGY analyzed records maintained by Motor Challenge program administrators to establish the universe of establishments that had participated in various components of the program. In most cases, program records were maintained on *individuals*, for example: registered MotorMaster+ users or attendees at training programs. However, changes in motor system purchase or specifying practices are made at the *establishment* level. Therefore, the first step in characterizing these changes and estimating associated energy savings was to ensure that the lists of individuals receiving materials and services from the program were as complete as possible. The second was to transform the lists of individuals into a list of the unique end-user facilities and vendor establishments those individuals represented.
- ***To what extent did Motor Challenge participants adopt the "best practices" recommended and supported by the program's tools, informational materials, and training services?*** The Motor Challenge tools and services were each designed to encourage and enable end users and vendors to take specific actions in their businesses to improve motor system energy efficiency. These included upgrading the efficiency of motors upon replacement, replacing instead of repairing or rewinding motors upon failure, using energy-efficient configurations of components and controls in pump, fan, and air compressor systems, and practicing a wide range of preventive maintenance. Once we determined the range of tools, materials, and services a Motor Challenge participant had received, the next step was to determine the extent to which that establishment had adopted the practices supported by those specific program elements. This was accomplished for groups of end-user and vendor participants through telephone evaluations.
- ***What portion of reported changes in motor system practices were attributable to Motor Challenge?*** For research operations, this question is usually phrased: What portion of the changes would likely have been made in the absence of the program? In the assessment, we probed this question from a number of angles. For example: What had the participants' motor system purchase or specification practices been prior to receiving tools and information from the program? How much knowledge of energy-efficiency issues did participants have prior to contact with the program? In what specific ways was the information received from the program used to support changes in the subject practices?

What other factors affected the subject decisions? What, in the participant's opinion, was the likely course of events in the absence of the program tools and information? XENERGY used information from other market research to supplement the analysis. These analyses resulted in the estimation of a "net" number of motor systems affected by the program.

- ***How much energy did changes in motor-system practices attributable to the Motor Challenge program save?*** Savings estimation methods varied depending on whether the participant was a vendor or end-user and on the specifics of the program materials and services provided. For *end users*, we generally used the following sequence of steps to estimate energy savings for selected facilities.

  1. *Identify the energy-saving measures targeted by the Motor Challenge tools and services the selected customer received.* For example, MotorMaster+ was specifically designed to provide cost/benefit analysis of motor selection and replacement options. Thus, the target measures were to replace failed motors that would otherwise have been repaired or rewound and to select premium efficiency motors for replacement or new applications.
  2. *Estimate the total annual energy use of motor systems* ***potentially*** *affected by the measures at the selected facility.* In the case of MotorMaster+, this was the annual energy use of the motors that failed during the year, plus the energy use of motors purchased to power new applications (if any). XENERGY combined information from the assessment with results of the *Market Assessment* to estimate the base level energy use for the motor systems affected by the measures.
  3. *Estimate the annual energy use of systems affected by measures taken* ***as a result of participation in the program.*** This calculation applied the results of the analysis of net program effects to the estimate of total energy use for affected systems developed in Step 2 above.
  4. *Estimate the energy savings associated with measures taken as a result of participation in the program.* This was accomplished by applying measure-specific "savings fractions"[2] developed for the *Market Assessment* to the results of Step 3. The savings fractions in the *Market Assessment* were developed using a variety of sources, including engineering analysis, documented savings from case studies and utility DSM programs, and an assessment of industry experts.

  Once the program-related energy savings were estimated for each selected site, the results were projected to the population of participants using standard statistical methods.
  We used a similar approach to estimate savings associated with changes in vendors' motor system specification and sales practices. In those cases, however, the total potential energy use affected by the measures were based on estimates of the annual volume of systems sold or specified by the selected vendors and consultants.

See Sections 3 and 4 of this report for more details on the evaluation methods used.

1.2.4 Perspectives on Selection of Evaluation Methods

As in all program evaluations, the methods deployed for this study represent the result of practical accommodations and trade-offs among a number of factors. These included OIT's research priorities, schedule, and budget. In addition, XENERGY faced a number of constraints that are typical of *post hoc* evaluations. First, over the 5 years of operation prior to the evaluation, the program had experimented with a wide variety of different approaches. Some early components of the program had been terminated or significantly altered. Thus, we had to group various similar kinds of program initiatives together and isolate their common components for evaluation. Second, program record keeping procedures and databases had been designed, quite appropriately, to support program administration and to minimize the

[2] The term "savings fractions" here denotes the ratio between potential annual energy savings and total annual energy use for a specified motor system or set of motor systems with common application within a given facility.

reporting burden on participating end users and vendors. Thus, information about participants that was important for evaluation procedures, such as determining the group and projecting results to the population of participants, was often missing from program records. OIT and its contractors are currently adopting participant tracking procedures that will greatly facilitate evaluation and program marketing in the future.

Beyond these typical program evaluation challenges, the reader should be aware of the following in interpreting the results of this evaluation.

Importance of "second order" effects in assessing program accomplishments. Program-related energy savings occur when something happens in the end-user facility that would not have happened in the absence of the program. In the case of Motor Challenge, these events would include the installation of premium efficiency instead of standard motors; replacement of failed motors that would ordinarily have been repaired and returned to service; the use of on-site measurements and load profiles instead of "rule of thumb" to guide compressed air system design; and the implementation of new preventive maintenance routines. For program elements addressed directly to end users—say the dissemination of the MotorMaster+ program—it is relatively straightforward to quantify these effects (at least conceptually). One needs to develop a list of all the facilities that received the software, interview customers at a selection of those facilities to characterize the effect of the software on their motor purchasing practices, and project the results to the population of all customers receiving the software. This, in fact, is the approach we used for program elements that dealt directly with end users.

However, early in the program's development, its administrators realized that they needed to tap the interests and outreach capabilities of vendors, industry organizations, and utilities to get Motor Challenge tools into the hands of a significant number of end users. None of the Allied Partners contacted for this study were willing to furnish the names of customers whom they served using tools and materials from Motor Challenge. In many cases, it was clear that they had not kept track of this information. Thus, for the Allied Partner elements of the program, we needed to develop proxies for program effects at the facility level. For vendors who sold equipment, we collected information on the volume of sales of key motor system components, changes in the share of efficient components, and vendor attribution of those changes to the Motor Challenge program. For utility programs, the chain of events between the Motor Challenge intervention—a provision of MotorMaster+ to guide program planning—and changes in energy use at the facility level was even longer and more subject to variability.
We address the challenges of characterizing secondary effects by explicitly stating the assumptions used to estimate energy savings, clearly identifying the sources for assumed quantities, and selecting the most conservative among the various options. We discuss these assumptions in presenting the results for each program component. We believe the results obtained through these methods provide at least a reliable basis to compare the effects of various components of the program. They can also inform decisions regarding the relative value of efforts to increase the level of documented information available for evaluation of different program components.

Use of savings fractions and industry average consumption factors to estimate gross energy savings. Given the program's national scale, long operating period, variety of energy-saving measures supported, and diversity of customers served, collection of site-specific data such as electric bills or equipment inventories to support savings estimates was infeasible. Moreover, it is not clear how such information could have been processed in a consistent way to estimate gross energy savings. For each selected facility, we developed estimates of motor system energy using site-specific measurements of size, such as number of employees or motors purchased, and annual energy use factors specific to the facility's SIC category. These energy use factors were based on the results of the motor system inventory of 254 manufacturing facilities undertaken for the *Market Assessment* and included energy use per employee and energy use per motor. Where possible, we checked these estimates against energy consumption information provided by the interviewee. The savings factors discussed above were then applied to appropriate energy estimates to generate energy savings estimates.

Of course, there is significant site-to-site variation in motor energy use per employee, even within 2-digit SIC categories. So too is there variation in the level of energy savings that can be achieved through a given type of measurement. However, there is no way to capture this kind of information at the facility level short of the intensive on-site data collection and processing carried out for the *Market Assessment.* Therefore, we found it was best to use the results of the *Market Assessment*, coupled with site-level information that interviewees could reliably provide, to arrive at energy use and savings estimates. This approach has the further benefit of limiting the potential for finding outlandishly large effects at a given site due to measurement problems or other anomalies, which may, in turn, lead to inflated estimates of overall program effects when they are weighted up to the population.

Overlap of end users affected by different program components. It is possible that some of the end users who received tools and services directly from the program were also involved in projects planned and implemented by vendors who used Motor Challenge tools and services. Thus, it is possible that Allied Partners who reported changing the share of efficient equipment sold or specified were referring to projects attributed to the effects of the program in interviews with end users. We tried to minimize potential double counting by addressing the savings achieved by vendors, consultants, and other supply-side market participants through assessing only those groups who participated in program components other than the registered MotorMaster+ users (Allied Partners or Training Sessions). Also, in analyzing program elements addressed to end users, we went to great lengths to identify and eliminate duplicate listings of individual facilities.

For some program elements, we assumed that there would be a high degree of overlap and therefore did not undertake separate estimates of program effects. The most important example of this strategy is our treatment of the Information Clearinghouse. For purposes of this study, we assumed that information sent by the Clearinghouse was generally used in conjunction with other program materials and services, such as the MotorMaster+ software or technical training, for which a higher level of documentation was available. Therefore, we do not attribute effects or savings to the Clearinghouse independent of other components.

1.3 Structure of the Report

The remaining sections of this report cover the following topics:

- ***Section 2: Program Description*** provides a detailed description of all elements of the program and a narrative of their development.
- ***Section 3: Effects of End-User Components*** presents evaluation methods and findings regarding program effects on end-user practices and associated energy savings.
- ***Section 4: Effects of Non-End-User Components*** presents evaluation methods and findings on the program's effects on Allied Partners and other supply side actors practices in regard to the promotion, sale, and specification of energy-efficient motor systems and associated energy savings.
- ***Section 5: Conclusions and Recommendations*** places the evaluation findings in the context of current market conditions and provides suggestions to enhance the effectiveness of the program.

Section 2
Program Description

2.1 Program Objectives

Motor Challenge pursues an objective to develop best practice information and tools in cooperation with industry associations and energy efficiency organizations and then to distribute technical products and training either directly by the Program, or through Allied Partners (vendors and others), to end users of motor systems to promote a systems approach in the way these systems are managed, maintained, upgraded, and improved.

Motor Challenge was launched in October 1993. From the start, the program faced the challenge of changing ingrained business and engineering practices among end users and vendors without resorting to providing them with financial incentives. In the first 3 years of operation, the program experimented with a variety of program activities, services, and delivery strategies. Within the past 2 to 3 years, the program has settled on the following two core strategies and activities.

- ***Tool Development.*** The program's primary technical activity is to develop a set of technical decision tools to support end users in their efforts to identify and implement cost-effective motor system efficiency measures, as well as vendors and others in their efforts to promote and sell efficiency-related products and services.
- ***Partnership Development.*** The program is actively cultivating partnership arrangements with vendors, consultants, industry associations, utilities, and government agencies to accomplish a number of objectives. These include expansion of dissemination channels for program tools; development of new tools, services, and program components; and joint action on a variety of matters, including customer education and development of equipment standards.

Throughout the development of Motor Challenge, the following technical and program design principles have guided program managers.

- ***Promote a "systems" approach.*** Industrial engineers have long known that careful matching of the elements of a motor system—motors, controls, couplings, and process machinery—to the work to be performed yields far more savings than upgrading the efficiency of the individual components. The practical procedures and the benefits of the systems approach are stressed in program tools, publications, and case studies.
- ***Harness the business motivations of end users, manufacturers, and vendors in disseminating technical information and promoting energy efficiency.*** Throughout, Motor Challenge has emphasized not only the energy savings associated with improved motor system efficiency, but other benefits of efficiency improvements. These include increased control over production processes, reduced waste, and an improved production environment for workers. The program has also sought to work with manufacturers and vendors to identify and exploit competitive advantages associated with promoting efficient motor systems.

2.2 Current Motor Challenge Offerings

2.2.1 Technical and Business Decision Tools

The following paragraphs briefly describe the most frequently requested tools developed and distributed by the Motor Challenge. OIT is now undertaking a major tool re-engineering effort to design tools that are easier to use by both end users and suppliers. The tools will also be designed to lead customers and

vendors through the steps of profiling motor system energy use within a facility, identifying cost-effective opportunities to save energy, and implementing energy efficiency actions.

- ***MotorMaster+ Motor Selection and Management Software.*** MotorMaster+ contains a database of efficiency, price, and other catalog information for more than 25,000 3-phase, integral horsepower electric motors produced by major manufacturers. Using this database, the algorithms contained in the program, and information on motors currently in use, vendors and end users can identify specific models that will provide the most cost-effective replacement for a failed motor, given its specific size and application. The program can also be used to analyze the benefits of replacing versus repairing a failed motor. Other modules support motor inventory management. To date, over 23,000 copies of MotorMaster+ have been distributed to end users, vendors, consultants, utilities, and government agencies. Utility and government program managers have also used the MotorMaster+ database to set product eligibility requirements and incentive levels for premium efficiency motor rebate programs.
- ***Pumping System Assessment Tool (PSAT).*** PSAT estimates pump system efficiency based on a limited number of on-site measurements. It will assess the overall efficiency of a pump system relative to its optimal performance. This information can then be used to determine if further engineering analysis is justified to improve the pump itself and its system components and controls.
- ***ASDMaster.*** ASDMaster is a software program that assesses the feasibility and cost-effectiveness of adding Adjustable Speed Drive controls to a motor system. The program was developed under the auspices of the Electric Power Research Institute (EPRI). Motor Challenge has licensed this software from EPRI, sponsors training in its use, and distributes the software to trainees.
- ***AirMaster.*** AirMaster is a computer-based compressed air system assessment product. Its primary purpose is to estimate compressed air system energy use and load profile based on a guided set of on-site observations and measurements. This information can then be used to estimate the potential savings from a variety of common compressed air system efficiency improvements. The product has recently been significantly revised to make it easier to use.

2.2.2 Training Programs

Motor Challenge has conducted or co-sponsored technical training sessions in a wide range of motor system topics including: use of MotorMaster+ and motor selection; basic pump system efficiency topics and recently the use of PSAT; basic ASD operations and use of ASDMaster. To date, 4,536 individuals representing an estimated 2,923 establishments have registered for these courses. Approximately 59 percent of these were commercial and industrial end users; the remainder were vendors, consultants, utilities, and government agencies.

2.2.3 Showcase Demonstrations

Showcase Demonstrations develop information on the field performance of efficient motor system technologies and design practices. In exchange for technical assistance from the Program's technical experts, customers arrange for monitoring and verification of energy savings associated with various motor system efficiency measures. Motor Challenge uses the documentation of the Showcases to develop case studies on advanced technologies that facility managers can use to assess the applicability of similar measures to their own facilities. To date, 13 technical motor system case studies have been developed.

2.2.4 Information Services

The Motor Challenge compiles and disseminates technical information on a wide variety of motor system topics through the following channels: a staffed information clearinghouse, a World Wide Web site, a newsletter distributed to over 25,000 individuals, and through the Allied Partner network (see below). The materials distributed through these channels include:

- Technical guides to identifying and implementing motor system efficiency measures.

- Sourcebooks on a variety of motor system topics, including motors, adjustable speed drives, and compressed air systems.
- Case studies of successful motor system efficiency projects, including complete narratives of the Showcase Demonstration projects.
- Major research reports commissioned by OIT, such as the *Market Assessment.*

Table 2-1 shows the volume of information requests handled by the Information Clearinghouse. Cases handled represent instances where Clearinghouse staff used program resources to address specific technical questions from callers (as opposed to fulfilling orders for publications). By the end of 1998, the Clearinghouse had handled over 11,000 requests for information and 1,100 technical assistance cases.

Table 2-1
Volume of Information Clearinghouse Activities

Cumulative Number of	FY 1997			FY 1998			
	1Q	2Q & 3Q	4Q	1Q	2Q	3Q	4Q
Requests	1,998	5,021	6,561	7,888	9,004	10,387	11,082
Technical Assistance Cases	138	364	505	636	817	965	1,101

2.3 Program Delivery Channels

2.3.1 End-User Direct Channels

Initially, Motor Challenge employed a partnership approach to deliver program services. The Motor Challenge Partnership was begun in 1995. To become a Partner, an organization completed an application and signed an agreement committing to pursue the goals of the program. Partners were provided access to the information clearinghouse, the decision tools (any partner employee could register for and receive a copy of MotorMaster+ software), some training opportunities free of charge, the newsletter, and a variety of free publications. Motor Challenge Partners were under no obligation to implement specific practices, designs, or equipment purchases. Figure 2-1 shows the number of partners in the program by type through the end of 1998.

Active recruitment of end users into the Partners program was discontinued in late 1997. However, individuals receiving products were requested to register themselves with the Program. As Figure 2-1 shows, a small number of end users continued to enroll through the end of 1998. The termination of recruitment for the Partners program was consistent with Motor Challenge efforts to reduce obstacles to companies seeking technical assistance and materials from the program. This move was also consistent with the increasing emphasis placed on Allied Partners for the dissemination of program materials.
In addition to the Partners program, Motor Challenge developed a variety of channels to reach end users directly. These included the *Turning Point* newsletter (renamed *Energy Matters* in 1999), extensive placement of articles in trade and industry publications, two nationwide teleconferences, and training programs, as well as the provision of information on demand through the Internet and the information clearinghouse. Finally, the program deploys a number of account representatives to market the program directly to larger end users. Figure 2-2 shows the chronology of the development of these “end-user direct” channels as well as of other program elements.

2.3.2 Allied Partnerships

Beginning in 1996, the Motor Challenge directed significant staff, contractor, and field representative effort towards building Allied Partnerships. The basic concept behind the Allied Partnerships is to harness the interests and capabilities of organizations that have direct contact with motor system purchasers and vendors in order to disseminate Motor Challenge tools and materials. Most Allied Partners fall into two categories. The first consists of vendors and consultants who have direct commercial relationships with end users. The second consists of utilities, government agencies, and

industry organizations that attempt to influence the behavior of end users, vendors, and other constituents through programs of various kinds. Recruitment for the program began in June 1996. At the end of FY1998, there were 104 Allied Partners in the Vendor and Consultant Category; 96 in the Utility and Government Category; and 8 manufacturers. See Figure 2-3 for the growth in Allied Partnerships over time.

Figure 2-1
Number of Motor Challenge Partners

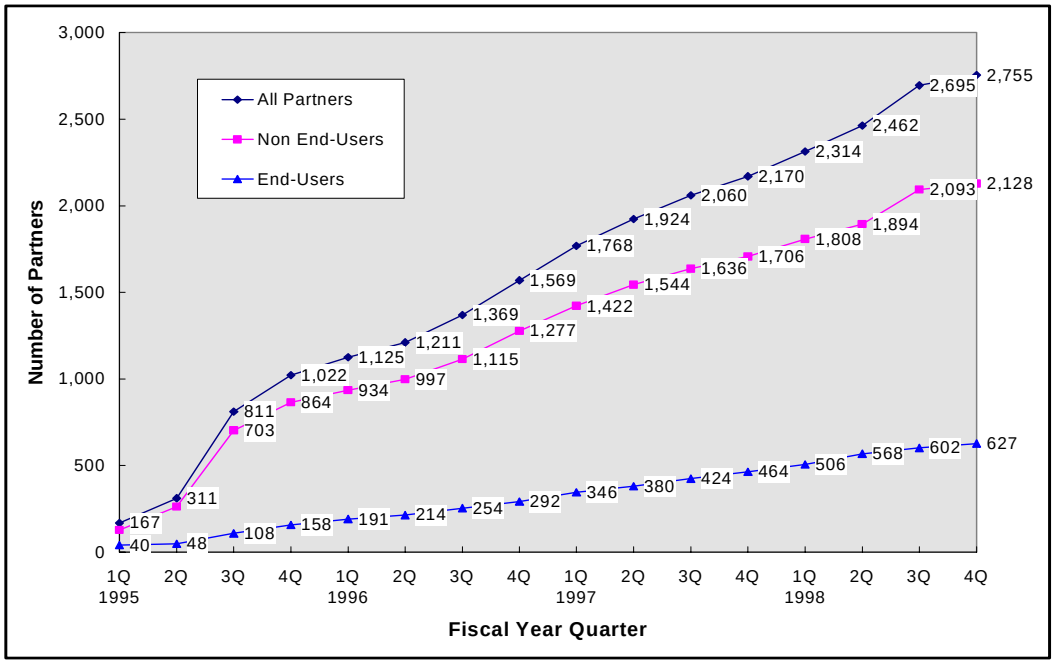


Figure 2-2
Chronology of the Development of
Selected Motor Challenge Program Elements

	FY 1994				FY 1995				FY 1996				FY 1997				FY 1998			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
End-User Initiatives																				
→ Information Clearinghouse	Offer Publications, Technical Assistance, Software, Other Information, Web Page																			
→ Decision Support Tools	MotorMaster										MM+ 1.0			MM+ 2		ASDMaster				MM+ 3
→ Newsletter				*Turning Point* 1st Issue Winter 1994																**
→ Showcase Demonstrations					Call for		Develop IPVs					1st case study published								
→ Training						Motor Systems & MM					MM&pmp		motors & MM			mot&ASD		mot,ASD&pumps		
→ Teleconference						1st												2nd		
→ Partner Program																	end recruitment			
Allied Partnership											Enrolling		Shift Focus to Implementation							
Industry Partnerships											CAGI, HI, AMCA, EASA, NEMA, TAPPI					TAPPI joins active AP				
																	Comp.Air Challenge			
																		Steam Chall.		

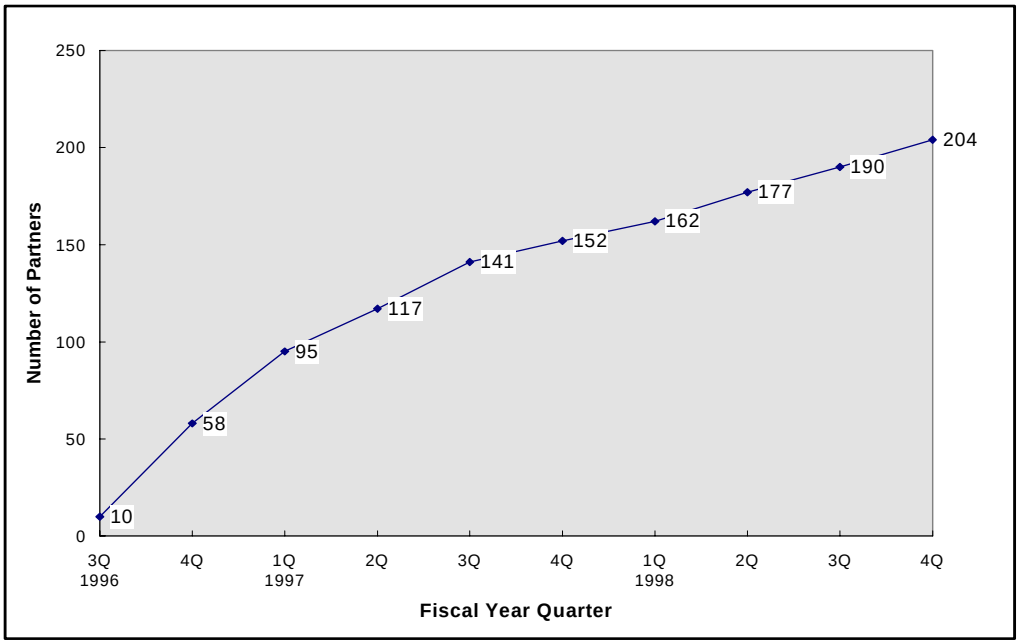
** *The Turning Point* renamed to *Energy Matters*

Allied Partners agree to promote energy efficiency with their customers, as well as within their own organization. Each Allied Partner is asked to complete an Action Plan outlining the activities they agree to undertake—product dissemination, training, etc. In exchange, Motor Challenge makes most of its resources available to Allied Partners in quantity at no or minimal cost. Allied Partners have access to a broad array of Motor Challenge publications and decision tools, which they can distribute to industrial end users in the course of their daily business or in conjunction with customer education meetings or workshops.

Vendors and Consultants. Among vendors, Allied Partners are primarily distributors, dealers, and consultants who perceive a value in providing their own customers with information on how to increase the energy efficiency of their facilities. Based on assessment results, these organizations have distributed approximately 1,800 copies of MotorMaster+. Some Allied Partners were able to achieve a high degree of leverage for the program. For example, one vendor trained over 2,700 individuals in the use of MotorMaster+.

Governments, Utilities, and Trade Associations. Motor Challenge also approached utilities and government agencies with an interest in industrial energy efficiency to become Allied Partners. These organizations used the technical resources available from Motor Challenge—in particular MotorMaster+—to help structure their own programs to promote the purchase of energy-efficient motors. They also distributed tools and information to vendors and end users that participated in their programs. As of the end of 1998, 56 electric utilities, 16 government agencies, and 24 trade and research organizations were registered as Allied Partners. Altogether, these organizations worked with over 12,000 end users using Motor Challenge tools and materials. Over 8,000 copies of MotorMaster+ were distributed through this channel. Many of the industry organizations enrolled as Allied Partners represented multiple vendors. For example, the Electric Apparatus Service Association (EASA) distributed Motor Challenge materials to its 2,000 domestic members.

Figure 2-3
Growth in Number of Allied Partners, 1996 - 1998



Industry Partnerships. Over the past several years, Motor Challenge has developed partnerships with associations representing important groups of end users, manufacturers, and vendors in the industrial motor system markets. The basic approach has been to harness OIT's technical resources to address motor system-related technical issues and opportunities that are specific to the industry in question and affect a broad range of the associations' members. Industry partnerships also serve as the main vehicle to

develop new types of information, tools, and training offerings. Examples of these partnerships include the following.

- ***The Compressed Air Challenge.*** In 1997, Motor Challenge developed an industry partnership with the Compressed Air & Gas Institute (CAGI), a trade organization of 45 manufacturers of compressed air system equipment. Nine sponsors, including CAGI and DOE, donated substantial funding to create a Compressed Air Efficiency Council in the fourth quarter of FY1997. This council was formed to increase customer awareness and develop national professional training and certification programs for plant engineers. In the first quarter of FY1998, the initiative was renamed "Compressed Air Challenge" and began developing marketing materials. The Compressed Air Challenge's first program initiative was to develop an introductory training program on compressed air system efficiency. The training sessions were rolled out in 1999, and over 1,400 people have been trained as of September 1999.
- ***Pump System Initiative.*** The Hydraulic Institute (HI), a trade organization of approximately 70 pump manufacturers, has marketed a video training program entitled "Energy Reduction in Pumps and Pumping Systems" with student and instructor workbooks. HI has formed a "Life Cycle Costing" committee with DOE's facilitation assistance that will be developing products to assist end users to address life cycle cost factors in managing and maintaining their pump systems.
- ***Pulp and Paper Industry Initiative.*** The Technical Association of the Pulp and Paper Industry (TAPPI) became an Allied Partner in fourth quarter FY1997 and distributed over 400 copies of MotorMaster+ to pulp and paper mills across the country. TAPPI has 33,000 members and provides Motor Challenge tools and information to them mostly free of charge. Recently, TAPPI has begun to distribute Motor Challenge materials through its own trade publication channels, and Motor Challenge-related topics have been featured prominently in TAPPI conferences.

2.4 Estimate of Program Activity Volume

As discussed in Section 1, impact analysis for most of the program components requires that we develop an estimate of the number of end-user facilities served, as well an estimate of the number of "units of service" delivered. Table 2-2 summarizes this information for key program components from program inception through September 1999. Sources for the "Units of Service Delivered" column consist primarily of program records and Quarterly Progress Reports. The methods used to estimate the number of end-user facilities served are summarized in the notes to the table. For some of the program components, such as fulfillment of publications requests by the Clearinghouse or distribution of publications by Allied partners, it was impossible to develop a plausible estimate of the number of facilities served.

Table 2-2
Indicators of Motor Challenge Program Activity Volume

Program Activity	Units of Service Delivered	Number End-User Facilities Served
End-User Direct Channels		
Publication Requests	11,082	N/A
Technical Assistance Cases	1,101	N/A
Bimonthly Newsletter	25,000	˜7,900[1]
Copies of MotorMaster+ distributed	6,387	˜1,900[2]
Motor Challenge Partners	N/A	943[3]
Technical Training Workshops	31 sessions	443[4]
Allied Partner: Vendors and Utilities		
Training Modules Ordered	182	N/A
Training Events Sponsored	98 sessions	1,282[4]
Copies of MotorMaster+ Distributed	17,150	˜5,100[2]
Publications Distributed	120,500	N/A

1 Recent assessment of *Energy Matters* newsletter readers found that less than half were end users. XENERGY applied ratio of MotorMaster+ copies distributed to end users/unique facilities to estimate number of facilities receiving the newsletter.
2 XENERGY estimate based on ratio of copies shipped/separate establishments for registered MotorMaster+ users.
3 The Motor Challenge Partnership program component was suspended in 1997. These end users were included in the MotorMaster+ analysis.
4 Estimate based on average number of attendees per session for program-sponsored trainings.

Section 3
Effects of End-User Components

3.1 Overview

This section presents analysis of the changes in motor system purchase and management practices effected by end-user-oriented components of the Motor Challenge program and estimates of the energy savings associated with those changes. We define "end-user components" as those program activities designed primarily to encourage and equip facility managers with the tools they need to achieve motor system energy savings through changes in equipment purchase and management practices. By contrast, the "Allied Partner" components discussed in Section 4 are designed to encourage and equip vendors and public agencies to promote and sell efficient motor system equipment and related services. In some cases, Allied Partners distributed Motor Challenge tools, such as MotorMaster+, to end users. Some of these end users then went on to use these tools to guide motor system purchases and maintenance. For purposes of this evaluation, energy savings achieved by this population of end users as a result of their direct use of Motor Challenge tools and materials are attributed to the end-user components, regardless of the channels by which those tools and materials were distributed.[1]

Table 3-1 lists the end-user-oriented program components, the estimated number of facilities that were reached by each component, the number of facilities that took energy-saving measures as a result of their exposure to the component, and the estimate of energy savings associated with those measures in terms of MWh and thousands of dollars per year. Taken together, the two training programs in Adjustable Speed Drive (ASD) and pump system efficiency applications accounted for 32 percent of total savings from the end-user components. Only 305 facilities took action as a result of their representatives attending the training sessions. However, the savings per site associated with these actions were high—an average of 175 MWh per year. Energy savings associated with the use of MotorMaster+ to guide motor purchase and replacement decisions accounted for 30 percent of savings from the end-user components. The savings at each facility that reported using MotorMaster+ for this purpose averaged 78 MWh per year. We estimated that 18 percent of the facilities that received MotorMaster+ were using it to guide motor purchases.

Among the remaining end-user components, the largest in terms of participation and energy savings generated was the *Energy Matters* newsletter. According to a survey of *Energy Matters* newsletter readers carried out by MACRO International, the program contractor, roughly one-third used information they found in the newsletter to carry out some kind of motor system energy improvement. Rather than resurvey the same population, XENERGY combined the results of the MACRO International survey with information on site-level energy savings from other components to arrive at an estimate of energy savings associated with the *Energy Matters* newsletter. We followed a similar procedure for estimating energy savings associated with viewing the teleconference. Finally, we estimated energy savings from the Showcase Demonstrations by conducting in-depth interviews with the project managers at each site to characterize the influence of the Motor Challenge program on measure implementation. We combined these findings with case study information on energy savings for each site to arrive at an estimate of annual savings attributable to the Showcase Demonstration component.

[1] We assess the extent of potential overlap of effects between end user and Allied Partner components below, in connection with analysis of the impacts of the various components for which such an overlap can be hypothesized.

Table 3-1
Overview of End-User Component Impacts

Program Component	Number of Facilities Reached	Number Took Action due to MC	Annual Energy Savings	
			MWh/Year	$/Year (000s)
MotorMaster+ (registered users)	3,664	653	50,687*	$2,433*
ASD Training	370	87	22,475	$1,079
Pump Training	455	218	30,829	$1,480
Energy Matters Newsletter	7,937	2,646	35,173	$1,688
Teleconference	318	318	4,227	$203
Showcase Demonstration	13	9	24,148	$1,106
Total			***167,539***	***$7,988•***

* Includes 37 non-end-users that were outside the intended population frame.
• Does not add due to rounding.

The paragraphs below provide a detailed description of the effects of each of the end-user components on customers' motor system purchase and management practices, the methods for estimating energy savings, and the results of those calculations.

3.2 Registered MotorMaster+ Users

3.2.1 Introduction: Energy Savings Mechanisms and Estimates

During the period under evaluation, the MotorMaster+ software package was the program's most visible and widely used tool. The core modules of MotorMaster+ and its predecessors enable users to apply life-cycle costing principles to the selection of new motors to replace failed units and to the decision to replace a failed motor versus repairing and returning it to service. These, in fact, are the most frequently used modules of the program.[2] Program-induced energy savings occur when facilities staff that use MotorMaster+ to guide motor purchase decisions:

1. Purchase a higher proportion of energy-efficient motors than they would have if the software package were not available.
2. Replace a higher proportion of failed motors than they would have if the software package had not been available.

XENERGY completed the following basic steps to estimate the energy savings associated with each of the two mechanisms mentioned above.

[2] These modules could also be used to support decisions concerning motor sizing. Other modules support motor inventory management and preventive maintenance programs. These activities can lead to motor system energy savings. However, a study of MotorMaster+ use by MACRO (November 1998) found that very few facilities staff used the software package to support motor sizing or maintenance. We therefore did not question end-users about their use of MotorMaster+ other than to guide motor selection and replacement decisions.

Estimate population size.

- Analyze program records to estimate the number of end-user *facilities* (as opposed to individuals) that received registered copies of MotorMaster+.

For a group of registered MotorMaster+ users:

- Estimate the number of motors purchased and rewound in the year prior to the assessment.
- Estimate the number of premium efficiency motors purchased in the year prior to the assessment.

For savings from incremental purchases of energy-efficient motors:

- Estimate the number of energy-efficient motors that each selected end user would have purchased if MotorMaster+ had not been available.
- Use information from the assessment on each selected facility, combined with industry-specific energy use and savings fractions from the *Market Assessment*, to estimate energy savings due to the program-induced purchase of energy-efficient motors at each selected site. Then, sum the site level results to estimate savings due to efficient motor purchases by selected facilities.

For savings from incremental replacement (versus repair) of failed motors:

- Estimate the number of motors that each end user would have rewound instead of replacing if MotorMaster+ had not been available.
- Use information from the assessment on each selected facility, combined with industry-specific energy use and savings fractions from the *Market Assessment*, to estimate energy savings due to the program-induced replacement of failed motors at each selected site.

Project the results to the population. Then sum the site level results to estimate savings due to efficient motor purchases by selected facilities.

Almost 20 percent of the MotorMaster+ end users (36) indicated that they implemented some efficiency improvement as a result of the software. Table 3-2 displays key intermediate results in this estimating process. The following paragraphs detail the findings and describe customer response to MotorMaster+.

3.2.2 Frame Development and Group Selection

MotorMaster+ copies distributed and availability of records. According to Motor Challenge records, the program distributed 23,000 copies of MotorMaster+ during the evaluation period. Ideally, we would like to identify all individuals who received copies of the software when developing a group from which to estimate energy savings. However, the nature of the software distribution channels precluded developing a complete population list or frame. Over 17,000 copies MotorMaster+ were sent to Allied Partners for redistribution to end users and vendors. The Allied Partners were not strictly required to keep track of the distribution of those copies. However, Allied Partners did submit contact information to the Motor Challenge program for 6,826, or approximately 40 percent, of the MotorMaster+ packages they distributed. Faced with this situation, we decided to estimate energy savings for the group that received the 9,965 registered copies as of the end of FY1998. The savings estimates were also applied to the 2,250 additional registered copies distributed as of September 1999.

Table 3-2
Summary of Energy Savings Estimates
for Registered MotorMaster+ Users

	Purchase of Premium-Efficiency Motors	Replace versus Repair of Failed Motors
Estimated Population (N)		
Number of End-User Sites	3,664	3,664
Selected User's Savings (n = 202)		
Number of Systems Purchased/Rewound	16,272	13,183
Number of EE Motors Purchased[1]	7,285	n/a
% of group that changed practices due to MotorMaster+	*12%*	*11%*
Incremental EE Motors Purchased/Failed Motors Replaced	568	334
Energy savings associated with program-induced actions	541 MWh/year	2,146 MWh/year
Population Results		
Net Savings	9,812 MWh/year	38,930 MWh/year
Total for both measures		***48,742 MWh/year****

- This does not include the 37 non-end-users that were outside the intended population frame. The total when including the 37 non-end users is 50,687 MWh/year.

Analysis to identify the registered MotorMaster+ user population among end users. MACRO International furnished XENERGY with three sets of electronic files containing contact information for individuals who had registered copies of MotorMaster+ as of December 1998. Altogether these files contained records for 14,129 registrants from the following sources: Motor Challenge Partners (28.5 percent); Allied Partners (48.3 percent); and Information Clearinghouse (23.2 percent).

The first steps in creating the group of end-user facilities were to eliminate duplicate individuals and sort them by type of establishment. This was accomplished through computer sorting routines and visual inspection of the records. Table 3-3 shows the results of this operation. Representatives of end-user facilities accounted for 46 percent of the unique MotorMaster registered users. Although there are potential savings from each type of user, to avoid the likely overlap between end users and non-end-users, for this evaluation the savings achieved by vendors, consultants, and other supply-side market participants is addressed through assessments of those groups that participated in other program components (i.e., Allied Partners or Training Sessions). The results of this analysis are discussed in Section 4.

Inspection of the use of registered end users showed that there were many instances of multiple users at one facility. Because savings can only be estimated at the facility level, it was necessary to reduce the list to unique facilities. Grouping users by company name and facility address, we arrived at a final count of 2,963 sites for end users registered as of December 1998. The final population frame included the additional 2,250 individuals who had registered through the Information Clearinghouse between December 1998 and September 1999. These additional registrants were allocated on the same basis as the original registrants, resulting in an estimated 3,664 end-user facilities with registered copies of MotorMaster+.

Table 3-3
Unique Individual MotorMaster+ Registered Users
by Establishment Type through December 1998

Establishment Type	Number of Unique Registered MM+ Users	Percent of Unique Registered MM+ Users
End users	4,573	46%
Vendors and Consultants	3,062	31%
Utilities and Government	1,796	18%
Equipment Manufacturers	534	5%
Total	***9,965***	***100%***

Selection size. XENERGY conducted an assessment of end-user facilities to gather information needed to evaluate end-user response to MotorMaster+ and to estimate energy savings from actions taken due to use of the software. The selection of facilities was picked at random from the population frame described above. In most cases, the interviews were conducted with the contact person in the selected group. Where the initial contact was unavailable, we interviewed the plant manager or other individual familiar with Motor Challenge. The interviews lasted approximately 15 minutes and covered the following topics: type and size of facility; recognition of Motor Challenge; recognition and use of Motor Challenge tools and materials; number of motors purchased and rewound in the previous year in various size categories; use of MotorMaster+ in motor purchase and rewind decisions.

XENERGY staff conducted 19 interviews using a draft questionnaire. Based on the results of this test, the questionnaire was substantially revised for deployment as a computer-assisted, closed-ended assessment. We were able to use most of the data from the initial 19 interviews in the analysis. The telephone research contractor completed 220 interviews. Although the questionnaire contained a number of questions designed to screen out vendors and other non-end-users, close review of the study results suggested that 37 of the interviewees were vendors or other kinds of organizations that participated in the motor systems market as OEM manufacturers or research entities. Analysis of the savings these organizations achieved is similar to that for the end users. As the estimates cover simply the 37 interviewees themselves, the results are included without application of weights, and discussion is simply included as additional notes in this section. Thus, the detailed analysis of end-user savings among MotorMaster+ users is based on the results of 202 questionnaires.

3.2.3 Estimating Net Savings from Selection of Energy-Efficient Motors for Selected Establishments

Measure definition. During the period covered by this evaluation, the definition of standard efficiency changed for a large portion of integral horsepower motors sold in the United States. The Energy Policy Act of 1992 contained efficiency standards for three-phase NEMA Type B motors from 1 to 200 horsepower. Those standards were implemented in October 1997. After that date, all motors sold in the covered categories needed to comply with the Federal (or EPAct) efficiency standards. Those categories account for roughly 70 percent of integral horsepower motors sold in the United States.

Most motor manufacturers now produce units with efficiencies higher than the Federal standards in each of the applicable horsepower ranges. Although the nomenclature for these machines has not been consistent, most manufacturers refer to them as “premium efficiency” motors. Many manufacturers have adopted a set of standards promulgated by the non-profit Consortium for Energy Efficiency (CEE) for classifying products as “premium efficiency,” so there is some consistency of nomenclature in the market. The differential in efficiency between “premium efficiency” motors and EPAct standard motors is

substantially less than the differential in efficiency between EPAct and average efficiencies in the market prior to 1997. Specifically, upgrading from pre-EPAct average efficiencies to EPAct standards results, on average, in savings of 2.3 percent of motor system energy. Upgrading from EPAct to premium or CEE levels results in savings of 1.2 percent of motor system energy.[3]

In developing the questionnaire, we attempted to distinguish between end user's actions prior to and after the promulgation of the EPAct motor efficiency standards. Due to the time elapsed between October 1997 and the evaluation assessment (June-July 1999) interviewees to the draft questionnaires could not make this distinction. The issue was further clouded by the inconsistency in product nomenclature prior to 1997. We decided, therefore, to focus questions on the end user's practices in the year prior to the assessment. The EPAct standards were in force for and the term "premium efficiency" in wide use during this entire period.

In light of the above considerations, we defined the motor efficiency upgrade measure as the selection of CEE-level efficiency motors versus the EPAct standard. For end users who used MotorMaster+ to guide motor purchase decisions prior to October 1997, this definition may lead to the understatement of energy savings from past actions. However, it is an accurate definition for future purchases. The actual factors (fractions of total motor system energy use) representing energy savings associated with upgrading from EPAct to premium efficiencies were as follows:

- 1-5 horsepower—2.44 percent
- 7.5-20 horsepower—2.04 percent
- over 20 horsepower—1.18 percent
- overall—1.39 percent

Effect of MotorMaster+ on selection of premium-efficiency motors. The questionnaire contained a series of items that probed end-user's use of MotorMaster+ to guide motor purchase decisions. The key findings from this series are as follows:

- ***Use of MotorMaster+ in purchase decisions.*** Almost 40 percent of the selected end users reported that they used MotorMaster+ to help decide which motors to purchase. Of these, 21 percent reported that they used MotorMaster+ every time they purchased a motor over 1 horsepower. An additional 19 percent reported that they used MotorMaster+ most of the time they made motor purchases. See Table 3-4 for a summary of these results.
- ***Effect of using MotorMaster+ on motor selection.*** End users who reported using MotorMaster+ to guide their motor purchases were asked whether the percentage of premium efficiency units among the motors bought during the previous year would have been greater, less, or about the same if the software package had not been available. Fourteen percent of them reported that they would have purchased a lower percentage of premium efficiency motors if they had not had access to the software.[4]

[3] Savings will vary for a specific motor based on horsepower, part load, and hours of operation. See *United States Industrial Electric Motor Systems Market Opportunities Assessment* (1998), Section 2 for a complete discussion of population-level savings estimates.

[4] Five interviewees (2.5 percent of the group) reported that they would have purchased a higher percentage of premium efficiency motors in the absence of the program. Given the small size of this group and the small number of motors they purchased, we did not "subtract" their "negative savings" from the program total. We should also note that this is not necessarily a bad result. For motors with low hours of use, the economics of upgrading from EPAct to CEE efficiency levels are not particularly attractive.

The incremental percentage of premium efficiency motors purchased due to the use of MotorMaster+ ranged from 2 to 100 percent. The average increment attributed to the program was 35 percent; the median of the distribution was 33 percent.

Table 3-4
Use of MotorMaster+ in Motor Selection Decisions

n = 202	Numbers of End users
Did not use MM+ to guide motor purchases	122
Used MM+ to guide motor purchases	80
For every motor purchase	21%
For most motor purchases	19%
For half of motor purchases	19%
For less than half of motor purchases	28%
Hardly ever used	14%

- ***Relative importance of MotorMaster+ versus other purchase influences.*** Fifty of the end users who used MotorMaster+ to guide their motor purchased reported that they had also participated in utility-sponsored programs that offered rebates for the purchase of energy-efficient motors. We asked those end users how important MotorMaster+ and other Motor Challenge materials were in their decisions to purchase energy-efficient motors versus utility incentives. Among them, 26 percent reported that the information and analysis provided by MotorMaster+ was *more* important than the rebates in their purchasing decisions. An additional 36 percent reported that use of MotorMaster+ was equal in importance to the rebates in influencing their decisions.

Estimate of the number of premium efficiency motors purchased by selected establishments as a result of using MotorMaster+. End users were asked how many motors they purchased in the year prior to the assessment in three horsepower categories. The 202 selected establishments reported that they had purchased a total of 16,272 motors in the prior year. Purchases ranged from a minimum purchase of 1 unit to a maximum of 5,000 with an average of 80 units per end user. Table 3-5 shows the distribution of these reported purchases by horsepower category and shows the pattern of reported purchases for the selected establishments versus the pattern of motor shipments in 1997, the most recent year for which Census figures are available, and the distribution of motors in place in the manufacturing industry. This last comes from the *Market Assessment.*

Clearly the end users purchased a much higher percentage of large motors than would be expected for typical industrial firms. This finding reflects the generally large size of registered MotorMaster+ users overall. We used the reported number and distribution of motors by horsepower for each selected site in conjunction with size- and SIC-specific energy use factors developed from the *Market Assessment* to estimate motor system energy use for each site. On average, the group of registered MotorMaster+ users (end-user facilities) used 48,939 MWh per year in total electricity, versus 9,898 MWh per year for the average utility-sponsored motor program participant (2,475 MWh/year for the average industrial facility).

Table 3-5
Distribution of End User's Motor Purchases by Horsepower

Horsepower Group	Purchases	1997 Shipments[1]	Industrial Inventory[2]
1-5	25%	60%	59%
6-20	31%	26%	26%
>20	44%	14%	15%

[1] Bureau of the Census, *Current Industrial Reports*, 1998.
[2] U.S. Department of Energy, *United States Industrial Electric Motor Market Opportunity Assessment,* 1998.

After questioning the end users on the number and size categories of motors purchased, we asked what percentage of the motors was designated as premium efficiency by the manufacturer. They reported that 44.8 percent of the motors they purchased in the past year (or 7,285 units) were designated as premium efficiency. This is significantly higher than the percentage of premium efficiency motors shipped by manufacturers. A recent study undertaken for the Northeast Energy Efficiency Partnerships (1999) found that the penetration of premium efficiency motors was around 15 percent, based on interviews with manufacturers and a large selection of distributors in the region. It is possible that end users overstated the share of premium efficiency motors they purchased, given the relative newness of that product category and confusion over nomenclature. We assumed that the premium efficiency motors purchased were distributed over size categories in the same proportions as the overall purchases.

Estimate of the number of premium efficiency motors purchased due to MotorMaster+ and associated energy savings. To estimate energy savings for the group due to purchases of premium efficiency motors, we applied the results of the questions concerning the influence of MotorMaster+ on the past year's motor purchases to the total number of premium efficiency motors purchased for each site. This process produced an estimate of the total number of premium efficiency motors purchased by selected establishments due to the program of 568 motors.

Energy Savings. We then applied the appropriate energy use and energy savings factors to these "net purchases of premium efficiency motors" at each site and summed the energy savings over all selected sites. The total savings for the group were 541 MWh per year. Formula 3.1 shows the method used to arrive at this estimate.

$$savings_{upgrade} = \sum_{sample} number\ premium\ motors_{size\ bin} \times use\ factor_{size\ bin} \times savings\ fraction_{size\ bin} \quad [3.1]$$

3.2.4 Estimating Net Savings from Replacement v. Repair of Failed Motors for Selected Establishments

Measure definition. The *Market Assessment* found that industrial end users rewind 40 percent of the motors that fail each year. Because the percentage of motors repaired increases with horsepower size, the rewound or repaired motors represent 84 percent of the energy supplied by the portion of the stock in place that turns over each year. Moreover, most motors that are rewound are rewound at least twice; larger ones are rewound more often. Table 3-6 summarizes information on rewinding practices from the *Market Assessment.*

Table 3-6
Summary of Motor Rewind Practices

Horsepower Group	% of Failed Motors Rewound	% of Annual Stock Turnover (Units)	% of Annual Stock Turnover (Energy)
1-5	20%	12%	1%
6-20	61%	16%	6%
21-50	81%	7%	10%
51-100	90%	3%	11%
100-200	91%	2%	13%
>200	95%	1%	42%
Total		40%	84%

Source: U.S. Department of Energy, *United States Industrial Electric Motor Market Opportunity Assessment,* 1998.

Replacing a failed motor instead of rewinding it saves energy in a number of ways. First, as discussed above, efficiency standards for the largest portion of motors used in industrial applications were increased in 1997. The useful life of an integral horsepower motor ranges from 5 to 10 years, depending on annual hours of use. The *Market Assessment* found that only 9.1 percent of the motors in service in 1997 met EPAct standards. Thus, simply by purchasing a new motor instead of repairing it, the customer is likely to be upgrading efficiency. Second, most studies of the effects of rewinding on motor efficiency have found that some degradation of efficiency occurs each time a motor is rewound. The available studies are characterized by small samples and varied methods. However, the findings suggest that the efficiency degradation associated with rewinding falls in the range of 1 to 2 percent. Table 3-7 shows the efficiency gains associated with replacing a motor of pre-EPAct standard efficiency with an EPAct-compliant model versus repairing the failed unit.

For motors above 10 horsepower, the cost of replacing a failed unit exceeds the cost of repair. However, for most medium-sized and large motors with hours of operation over 4,000 per year, energy savings associated with purchasing a new motor offer paybacks of 3 years or less. MotorMaster+ supports calculations to identify and quantify such opportunities. Thus, to the extent that end users applied MotorMaster+ to identify motors to be replaced that they otherwise would have repaired, savings associated with those purchases can be attributed to the program.

Table 3-7
Efficiency Gains Associated with Replacing versus Repairing a Failed Motor

Horsepower Group	Efficiency Gain
1-5	4.9%
6-20	3.8%
>20	2.5%
Overall	2.9%

Source: *MotorMaster+* databases; XENERGY calculations.

Effect of MotorMaster+ on the replace versus repair decision. The questionnaire contained a series of items that probed end-user's use of MotorMaster+ to guide replace v. repair decisions. The key findings from this series are as follows.

- ***Use of MotorMaster+ in replace v. repair decisions.*** Twenty-one percent of the end users reported that they used MotorMaster+ to help decide whether to replace or repair failed motors. Of these, 22 percent reported that they used MotorMaster+ every time they purchased a motor over 1 horsepower. An additional 32 percent reported that they used MotorMaster+ most of the time they made motor purchases. See Table 3-8 for a summary of these results.
- ***Effect of using MotorMaster+ on the replacement decision.*** End users who reported using MotorMaster+ to guide replace versus repair decisions were asked whether the motors repaired in the previous year would have been greater, less, or about the same if the software package had not been available. Forty percent of those who reported using MotorMaster+ to guide replacement decisions (or 8 percent of the total) reported that they would have rewound a larger number of motors in the absence of the program. That is, 8 percent of the selected MotorMaster+ registered end users reported realizing savings through increased levels of motor replacement due to use of the software package.
- The incremental percentage of motors replaced due to the use of MotorMaster+ ranged from 10 to 100 percent. The average increment attributed to the program was 34 percent; the median of the distribution was 25 percent.

Estimate of the number of motors replaced instead of rewound by selected establishments as a result of using MotorMaster+. End users were asked how many motors they rewound in the year prior to the assessment in three horsepower categories. The 202 establishments reported that they had rewound a total of 13,183 motors in the prior year. Applying the findings from the question sequence described above to the estimate of total motors rewound, we estimated that selected end users rewound 334 fewer motors than they would have if MotorMaster+ had not been available.

Energy Savings. Finally, we applied the appropriate energy use and energy savings factors to these "net replacements of failed motors" at each site and summed the energy savings over all sites. The total savings for the group were 2,146 MWh per year. Formula 3.2 shows the method used to arrive at this estimate.

$$savings_{replace} = \sum_{sample} number\ replaced\ motors_{size\,bin} \times use\ factor_{size\,bin} \times savings\ fraction_{size\,bin} \quad [3.2]$$

Table 3-8
Use of MotorMaster+ in Replace v. Repair Decisions

n = 202	Number of End users
Did not use MM+ to guide replace/repair decisions	162
Used MM+ to guide replace/repair decisions	40
For every motor purchase	22%
For most motor purchases	32%
For half of motor purchases	8%
For less than half of motor purchases	16%
Hardly ever used	22%

3.2.5 Projection of Findings to Population

The objective in designing a sampling plan is to enhance our ability to make informed inferences pertaining to an entire population frame based on data collected from the selected portion. The approach is to extrapolate the group program savings to the population frame using a mean-per-unit estimator. This is the simplest estimator of a population total, given a group of observed data. The selected data can be

extrapolated to the population by applying weighting to the results, where the weights for units selected from stratum i is the inverse of the probability of having been drawn in that stratum:

$$weight_i = \frac{N_i}{n_i} \quad [3.3]$$

The population program savings using a mean-per-unit estimator can be calculated as:

$$Total\ \ program\ savings = \sum_i \left(\frac{N_i}{n_i} \times \left(savings_{upgrade} + savings_{replace} \right) \right) \quad [3.4]$$

Based on extrapolating the results from the group of registered end users, it was estimated that the population of end users provided the Motor Challenge program with 48,742 MWh/year of savings. An additional 1,945 MWh/year of savings were attributed to the non-end users who were assessed, resulting in a total of 50,687 MWh/year in energy savings. At the average industrial electric energy price of $0.048/kWh, these energy savings are valued at $2,432,971 per year. The discounted value of these savings over the useful life of the motors involved is $12,979,723.

3.3 Training Programs

3.3.1 Population and Selection Frame

Overview of training session attendance. Between September 1996 and October 1999, Motor Challenge conducted or co-sponsored 129 training sessions on motors, pumps, and drives. Over 4,500 individuals representing 2,900 separate establishments attended these training sessions. Attendees included representatives of commercial and industrial end users, vendors, consulting firms, utilities, and government agencies. MACRO International maintained basic information about each section, including the date, location, host, co-sponsors, and number of individuals attending. Table 3-9 summarizes this information by year and topic.

Table 3-9
Attendance at Motor Challenge Training Sessions

	Year				
Training Topic	**1996**	**1997**	**1998**	**1999**	**Total**
MotorMaster+	549	737	437	84	1,807
Motor System Efficiency		404	45	72	521
Motor Inventory Management			39		39
ASD Applications		130	808	85	1,023
Pump System Efficiency	501		508	137	1,146
Total	1,050	1,271	1,837	378	4,536

Selection frame and distribution of attendees by type. Lists of attendees were available only for a small subset of these training sessions, encompassing 546 attendees at pump system efficiency and ASD workshops. Our first task was to sort these lists by type of organization (end user versus vendor or other type of ally), thereby creating the group for assessment of training session attendees. Table 3-10 shows the results of this process.

Table 3-10
Breakdown of Available Training Attendance Records

	Attendees		Unique Establishments	
	Number	% of Total	Number	% of Total
ASD Training: End users	83	44%	68	50%
ASD Training: Vendors	105	56%	68	50%
Pump Systems: End users	249	71%	139	69%
Pump Systems: Vendors	101	29%	62	31%

As discussed in Section 1, the mechanisms by which vendors and end users realize energy savings, and the methods for estimating those savings are quite different. Therefore, different questionnaires were developed and administered to each group. In projecting results to the population, we used the ratios of vendors to end users as well as the ratios of individual attendees to unique establishments shown in Table 3-10. Lists of individual attendees were not available for the MotorMaster+, motor system efficiency, and motor management sessions. We believe that we picked up savings attributable to the MotorMaster+ training sessions by assessing a group of registered users (see above). In other words, whatever savings were attributable to the MotorMaster+ would overlap entirely with savings captured in the analysis of MotorMaster+ registered end users. The other two sessions had relatively few attendees. Therefore, we do not believe that the results below significantly underestimate the savings associated with the Motor Challenge training initiatives as a whole.

3.3.2 End-User Energy Savings: ASD Training

Estimate of number of ASD systems installed by selected establishments. Seventeen end users were assessed from the list of ASD training attendees. They were questioned regarding their application of information gained through the training session they attended. Of the 17 end users, less than half of them had implemented actions since the workshop. The end users who did take action, installed a total of 25 ASD systems in their facilities—the number of ASDs installed ranged from 1 to 10 with an overall average of 1.5 ASDs per site.

Estimate of number of ASD installations by selected establishments as a result of the training sessions. While only a few of the participants took action after the training sessions, many of those indicated that their actions would have been either "Not likely at all" or only "Somewhat likely" in the absence of the resources and knowledge they gained at the workshops. Applying these findings to reported ASD purchases, we found that 28 percent of the units that workshop attendees purchased after participating could be attributed to the program.

Energy savings. Applying appropriate energy use and energy savings factors to the "net number of installed ASDs" at each site and summed over the grouped sites results in the estimated energy savings as shown in formula 3.5.

$$savings_{ASD} = \sum_{sample} number\ ASDs \times use\ factor_{type/size\,bin} \times savings\ fraction \qquad [3.5]$$

The total savings for the group were 1,033 MWh/year.

3.3.3 End-User Energy Savings: Pump Training

Estimate of number of pump systems installed or improved by selected establishments. We interviewed 25 end users from the list of pump system training attendees. The end users were questioned

regarding their application of information gained through the training session they attended. Approximately 50 percent of them had taken actions as a result of the workshops. These end users implemented actions to upgrade or improve the efficiency on 50 pump systems and changed the operating and maintenance for 217 pump systems since participating in the workshops.

Estimate of number of pump systems installed or improved by selected establishments as a result of the training sessions. Based on the responses of end users as to the likelihood of implementing procedures or measures in the absence of the training workshops, almost 50 percent of the systems that were improved would not have been addressed without the assistance provided by the program. We estimate that 124 of the pumping systems upgrades were done as a result of the Motor Challenge program.

Energy savings. Applying appropriate energy use and energy savings factors to the "net number of improved pump systems" at each site and summed over the selected sites results in the estimated energy savings as shown in formula 3.6.

$$savings_{pump} = \sum_{sample} number\ pump\ systems \times use\ factor_{type/size\ bin} \times savings\ fraction \qquad [3.6]$$

Assuming the following savings factors based on the type of improvement:

- Speed controls—30 percent
- Parallel pumps or downsizing—20 percent
- Increase pump diameter or other—10 percent
- Operation & maintenance—2 percent

The total savings for the group were 1,694 MWh/year.

3.3.4 Projection of Findings to Population

As discussed previously, the objective in selecting a group of end users is to enhance our ability to make informed inferences pertaining to an entire population based on data collected from the group. The results from the ASD and pump system training attendees were extrapolated as:

$$Total\ program\ savings = \sum_{sample} \left(\frac{N_{ASD}}{n_{ASD}} \times savings_{ASD} + \frac{N_{pump}}{n_{pump}} \times savings_{pump} \right) \qquad [3.7]$$

Using formula 3.7, it was estimated that the 1,033 MWh/year of ASD end-user savings and the 1,694 MWh/year of pump system end-user savings provided the Motor Challenge program with 53,304 MWh/year of savings. Assuming the average industrial electricity price of $0.048/kWh, these savings are valued at $2,558,576 per year. Over the useful life of the motors, the discounted value of these savings is $13,649,814.

3.4 *Energy Matters* Newsletter and Teleconferences

In addition to providing software and training sessions, the Motor Challenge Program disseminates technical information through a variety of methods: a staffed information clearinghouse, a World Wide Web site, a bimonthly newsletter, and through the Allied Partner network. The newsletter, *Energy Matters*, is distributed to over 25,000 individuals—providing a forum for program communication, providing program updates and schedules, showcasing successful system efficiency efforts, and disseminating technical information on motor efficiency technologies. Motor Challenge has also promoted two teleconferences. These events featured a wide range of technical and management information presented by a panel of experts speaking on various aspects of motor systems. The presentations were followed by panel discussions where participants were able to forward questions to the panel.

Satisfaction surveys were conducted of both *Energy Matters* newsletter readers and teleconference attendees to assess their effectiveness. Combining information gathered through the surveys and this evaluation, we estimated impacts for these two program offerings.

3.4.1 Population Frame—Energy Matters

As mentioned, the *Energy Matters* newsletter is distributed to over 25,000 individuals—end users, vendors, consultants, utilities, government agencies, and research groups. Of the 25,000 copies, it is estimated that 12,250 go to end users—7,500 are sent through the program and another 4,750 go to a manufacturer who provides them to customers. Applying the same facility-to-copies ratio as determined for the MotorMaster+ end users, we assumed that these newsletters are read at 7,937 unique sites. Based on the reader assessment, we estimated that one-third of the *Energy Matters* end users or 2,646 facilities took some action.

3.4.2 Population Frame—Teleconference

Fifteen hundred individuals—end users, distributors, consultants, utilities, government agencies, and research groups—took part in the teleconferences. According to the follow-up assessment, 34 percent of the registrants (510) were end users. Applying the same facility-to-copies ratio as determined for the training sessions, it is assumed that these 510 attendees worked at 318 unique facilities. It was assumed that each of these end users took some action as a result of participation.

3.4.3 Estimation of Program Net Savings

To cover the variety of measures that these participants were likely to have undertaken, the unit impacts were calculated as a weighted average of the impacts found from the MotorMaster+ and end-user training components. The weighted average was then adjusted to account for size differences between the selected group and typical utility-sponsored motor program participants. The average facility usage in the selection of end users ranged from 48,939 to 127,482 MWh/year compared to the typical utility-sponsored motor program participant facility that uses 9,898 MWh/year. Using a size adjusted net impact of 13.3 MWh/year, it was estimated that *Energy Matters* readers have contributed 35,173 MWh/year in savings to the program, and teleconference attendees have provided an additional savings of 4,227 MWh/year.

Section 4
Effects of Non-End-User Components

4.1 Overview

This section presents analysis of the changes in motor system specification and sales practices effected by non-end-user-oriented components of the Motor Challenge program and estimates of the energy savings associated with those changes. We define "non-end user" or "Allied Partner" components as those program activities designed to encourage and equip vendors and public agencies to promote and sell efficient motor system equipment and related services.

Table 4-1
Overview of Non-End-User Component Impacts

Program Component	Number of Participating Organizations	Number Took Action due to MC	Annual Energy Savings	
			MWh/Year	$/Year (000s)
Allied Partner—Vendors & Consultants	104	68	88,352*	$4,241*
Allied Partner—Utilities & Government	95	90	93,840*	$4,501*
ASD Training	371	223	131,431	$6,309
Pump Training	202	101	15,724	$755
EASA (Domestic motor repair shops)•	1948	487	23,325	$1,120
Association of Facility Engineers		81	218	$10
Total			***352,890***	***$16,939◊***

* Includes adjustment for effects of distributing copies of MotorMaster+ directly to customers.
• This does not include the estimated 52 EASA members that are registered Allied Partners.
◊ Does not add due to rounding.

Table 4-1 lists program components, the estimated number of "suppliers" that were reached by each component, the number of facilities that promoted energy-saving measures as a result of their exposure to the component, and the estimate of energy savings associated with those measures in terms of MWh and thousands of dollars per year. Taken together, the two training programs in Adjustable Speed Drive (ASD) and pump system efficiency applications accounted for 42 percent of total savings from the end-user components. Only 324 "suppliers" influenced customers as a result of their representatives attending the training sessions. However, the savings per vendor associated with these actions were high—an average of 454 MWh per year or the equivalent of affecting three to seven end users. Energy savings associated with the "Allied Partners" accounted for 52 percent of savings—25 percent from Vendors & Consultants and 27 percent from Utilities & Government. The savings from each vendor that reported using Motor Challenge materials for this purpose averaged 1,299 MWh per year. The savings per Utilities & Government were slightly lower, 1,043 MWh per year.

The paragraphs below provide a detailed description of the effects of each of the non-end-user components on supplier's motor system specification and sales practices, the methods for estimating energy savings, and the results of those calculations.

4.2 Allied Partners

4.2.1 Introduction: Energy Savings Mechanisms and Estimates

The Motor Challenge works with many different kinds of organizations to ensure that program tools reach end users and vendors when they are making motor system purchase, management, and maintenance decisions. The basic concept behind the Allied Partnerships is to harness the interests and capabilities of organizations that have direct contact with motor system purchasers and vendors to disseminate Motor Challenge tools and materials. In general, Allied Partners fall into two categories: those that have direct commercial contact with end users and those who attempt to influence the behavior of end users and vendors. Given the differences in the type of services each group provides to end users, it was necessary to employ different approaches for calculating the savings implications.

The universe of Allied Partners was easily defined based on the list of 208 names provided at the beginning of the evaluation. As mentioned above, given differences in the services provided, the Allied Partners were segmented into the following categories:

- 104 Vendors & Consultants
- 96 Utilities & Government
- 8 Manufacturers.

4.2.2 Vendors & Consultants

The portion of the Allied Partners referred to as Vendors and Consultants (V&C) is comprised of companies that sell products and services directly to end users. Program-induced energy savings occur when vendors use Motor Challenge tools and materials to influence customers' motor purchase decisions:

1. Promote a higher proportion of energy-efficient motors than they would have if the tools and information were not available.
2. Promote the sale of a higher number of Variable Speed Drives (VSDs) than they would have if the tools and information were not available.
3. Promote replacement of a higher proportion of failed motors than they would have if the tools and information had not been available.

Among a selection of 20 vendors and consultants participating in the program as Allied Partners, over 60 percent reported they had used Motor Challenge materials to help convince customers to purchase energy-efficient motor equipment. Many had also made changes to their practices in regard to motor system design, specification, and sales, which resulted in increased energy efficiency for their customers. These changes included specification of energy-efficient motors, specification of ASDs instead of mechanical devices for speed control, and application of more efficient overall design and control schemes for pump and compressed air systems.

"The information provided by the Motor Challenge program (especially the MotorMaster+ software) acts as a "proactive tool," allowing consulting firms to convince companies to think about buying and using efficient motors. Clients cannot deny the possibility for real savings when MotorMaster+ clearly highlights the potential for real savings. It's a very convincing decision tool." [quote from Energy Consulting Company]

XENERGY went through the following basic steps to estimate the energy savings associated with each of the mechanisms mentioned above.

Estimate population size.

- Analyze program records to categorize Allied Partners as vendors and consultants.

For a selection of Allied Partner—Vendors & Consultants:

- Estimate the number of motors and VSDs sold in the year prior to the assessment.
- Estimate the number of premium efficiency motors sold in the year prior to the assessment.

From a population of 104 V&C, 14 Vendors, and 6 Consultants were reached. One additional consultant was interviewed, but was dropped from the selection due to incomplete information. The 20 were questioned regarding their involvement in the Motor Challenge program.

For savings from incremental sales of energy-efficient motors:

- Estimate the number of energy-efficient motors that each vendor would have sold if Motor Challenge tools and information had not been available.
- Use information from the assessment on each selected vendor, combined with energy use and savings fractions from the *Market Assessment*, to estimate energy savings due to program-induced sales of energy-efficient motors by each vendor. Then sum the vendor-level results to estimate savings due to efficient motor sales by vendors.

For savings from incremental sales of VSDs:

- Estimate the incremental number of VSDs that each selected vendor sold due to their use of Motor Challenge tools and information.
- Use information from the assessment on each selected vendor, combined with energy use and savings fractions from the *Market Assessment*, to estimate energy savings due to program-induced sales of VSDs by each vendor. Sum the site level results to estimate savings due to VSD sales by the vendors.

For savings from incremental replacement (versus repair) of failed motors:

- Estimate the number of motors that each selected vendor convinced customers to replace instead of rewinding using Motor Challenge materials.
- Use information from the assessment on each selected vendor, combined with energy use and savings fractions from the *Market Assessment*, to estimate energy savings due to program-induced replacement of failed motors by each vendor. Then sum the site level results to estimate savings due to efficient motor sales by vendors.

Project the results to the population.

Summary of Findings

Sixty-five percent of the V&Cs indicated that they were able to promote some efficiency improvement as a result of Motor Challenge. Table 4-2 displays key intermediate results in this estimating process. The following paragraphs detail the findings and describe vendor response to the program.

Use of Motor Challenge tools or materials in serving customers. The questionnaire contained a series of items that probed V&C's use of Motor Challenge materials. The key findings from this are:

- 90 percent of the selected V&C Allied Partners had used MotorMaster+ software.
- 50 percent had used training modules or services.

- 85 percent had used technical publications.

Effect of MotorMaster+ on available services. The questionnaire contained a series of items that probed V&C's use of MotorMaster+. The key findings from those that had used MotorMaster+ software are as follows:

- Supported motor selection—73 percent.
- Assisted in replace versus repair decisions—39 percent.
- Assisted in motor sizing—22 percent.
- Assisted in developing motor inventories—2 percent.

Estimating Net Savings from Sales of Energy-Efficient Motors for Selected Establishments

Measure definition. See discussion in Section 3.2.3.

Estimate of the number of premium efficiency motors sold by selected establishments. V&Cs were asked how many motors they sold in the year prior to the assessment in four horsepower categories. According to responses from the 20 V&Cs, together they sold a total of 27,314 motor systems.

Table 4-2
Summary of Energy Savings Estimates
for Allied Partner Vendors & Consultants

	Sales of Premium-Efficiency Motors	Sales of VSDs	Replace versus Repair of Failed Motors
Estimated Population (N)			
Number of V&C Sites	104	104	104
User Savings (n = 20)			
Number of Systems Sold	27,314	n/a	n/a
Number of EE Motors or VSDs Sold	8,785	1,909	n/a
% of group that changed practices due to MC	*45%*	*25%*	*30%*
Incremental EE Motors or VSDs Sold/Failed Motors Replaced	4,933	480	2,665
Energy savings associated with program-induced actions	1,911 MWh/year	6,969 MWh/year	8,050 MWh/year
Population Results			
Net Savings	9,937 MWh/year	36,238 MWh/year	41,861 MWh/year
Total for all measures			***88,036 MWh/year****

* This does not include adjustment for effects of distributing copies of MM+ directly to customers. The total including the effects of MM+ distribution is 88,352 MWh/year.

Table 4-3
Distribution of V&C's Motor Sales
by Horsepower

Horsepower Group	Sample Sales	1997 Shipments[1]	Industrial Inventory[2]
1 – 20	58%	85%	85%
21 – 100	26%	12%	12%
101 – 200	10%	2%	2%
>200	5%	1%	1%

[1]Bureau of the Census, *Current Industrial Reports*, 1998.
[2] U.S. Department of Energy, *United States Industrial Electric Motor Market Opportunity Assessment,* 1998.

Sales ranged from 24 to 10,000, with an average of 1,366 motors sold per Vendor/Consultant. Table 4-3 shows the distribution of these reported sales by horsepower category, as well as the pattern of reported sales for the selected establishments versus the pattern of motor shipments in 1997, the most recent year for which Census figures are available, and the distribution of motors in place in the manufacturing industry. This last comes from the *Market Assessment.*

After questioning the V&Cs on the number and size categories of motors sold, we asked what percentage of the motors were designated as premium efficiency by the manufacturer. They reported that 32.2 percent of the motors they sold in the past year (or 8,785 units) were designated as premium efficiency. This is significantly higher than the percentage of premium efficiency motors shipped by manufacturers. A recent study undertaken for the Northeast Energy Efficiency Partnerships (1999) found that the penetration of premium efficiency motors was around 15 percent, based on interviews with manufacturers and a large group of distributors in the region.

Estimate of the number of premium efficiency motors sold due to Motor Challenge tools and information and associated energy savings. To estimate energy savings for the group due to sales of premium efficiency motors, we applied the results of the questions concerning the influence of Motor Challenge information on the past year's motor sales to the total number of premium efficiency motors sold by each Vendor/Consultant site. This process produced an estimate of the total number of premium efficiency motors sold by selected establishments due to the program of 4,933 motors.

Energy Savings. We then applied the appropriate energy use and energy savings factors to these "net sales of premium efficiency motors" at each site and summed the energy savings over all selected sites. The total savings for the group were 1,911 MWh per year. Formula 4.1 shows the method used to arrive at this estimate.

$$savings_{upgrade} = \sum_{sample} number\ premium\ motors_{size\ bin} \times use\ factor_{size\ bin} \times savings\ fraction_{size\ bin} \quad [4.1]$$

Estimating Net Savings from Sales of VSDs for Selected Establishments

Estimate of the number of VSDs sold by selected establishments. V&Cs were asked how many VSDs they sold in the year prior to the assessment. According to responses from the 20 V&Cs, together they sold a total of 1,909 VSDs.

Estimate of the number of VSDs sold due to Motor Challenge tools and information and associated energy savings. To estimate energy savings due to sales of VSDs, we applied the results of the questions concerning the influence of Motor Challenge information on the past year's VSD sales. Those who

responded that they had used Motor Challenge materials to help convince customers to purchase VSDs as a way to achieve energy savings accounted for 480 units or 25 percent of the VSDs sold by those questioned.

Energy Savings. We then applied the appropriate energy use and energy savings factors (assumed to be 20 percent) to these "net sales of VSDs" at each site and summed the energy savings over all selected sites. The total savings for the group were 6,969 MWh per year. Formula 4.2 shows the method used to arrive at this estimate.

$$savings_{VSD} = \sum_{sample} number\,VSDs \times use\ factor \times savings\ fraction \qquad [4.2]$$

Estimating Net Savings from Replacement v. Repair of Failed Motors for Selected Establishments

Measure definition. See discussion in Section 3.2.4.

Estimate of the number of motors replaced instead of rewound by selected establishments as a result of using MotorMaster+. Six of the V&Cs stated that they were able to convince customers to purchase 2,665 motors that would otherwise have been repaired. Recall that the assessed vendors sold a total of 27,314 motors. This finding indicates that 10 percent of the motors that were sold were ones that would previously have been repaired or rewound.

Energy Savings. Finally, we applied the appropriate energy use and energy savings factors to these "net replacements of failed motors" at each site and summed the energy savings over all selected sites. The total savings for the group were 8,050 MWh per year. Formula 4.3 shows the method used to arrive at this estimate.

$$savings_{replace} = \sum_{sample} number\ replaced\ motors \times use\ factor \times savings\ fraction \qquad [4.3]$$

Projection of Findings to Population

As discussed in Section 3.2.5, the objective in designing a selection plan is to enhance our ability to make informed inferences pertaining to an entire population frame based on data collected. Formula 4.4 shows the method used to arrive at this estimate.

$$Total\ \ program\ savings = \sum_{i} \left(\frac{N_i}{n_i} \times \left(savings_{upgrade} + savings_{VSD} + savings_{replace} \right) \right) \qquad [4.4]$$

Based on extrapolating the results from the selection of Allied Partner V&Cs it was estimated that the 16,991 MWh/year of savings from the group represented a total of 88,352 MWh/year that the entire population of Allied Partner V&Cs provided for the Motor Challenge program. This includes the effects of distributing 364 copies of MotorMaster+ directly to their customers. At the average industrial electric energy price of $0.048/kWh, these energy savings are valued at $4,240,872 per year. Over the useful life of the motors, the discounted value of these savings is $22,624,741.

4.2.3 Utilities & Government

The other category of Allied Partners, referred to as Utility & Government (U&G), covers agencies and companies who attempt to influence the behavior of end users and vendors though a variety of programs. They do not sell specific products and services directly. Program-induced energy savings occur when

utilities use Motor Challenge tools and materials to influence the design of programs or services to customers.

Ninety-five electric utilities and government agencies used Motor Challenge materials and tools to structure or enhance their own programs to increase motor system efficiency for their customers and constituents. Typically, they distributed MotorMaster+ or used the database and analysis to structure incentives to customers for purchasing premium efficiency motors.

Overall, the U&G program managers interviewed found the Motor Challenge tools extremely useful. *"This isn't a 'pie in the sky program' that has no influence on people's bottom lines. It's viewed as practical, useful, and is generally welcomed by most manufacturing, commercial, and industrial facilities. At least this is the feeling [we have] gotten over the years." [quote from Electric Utility program manager]*

XENERGY went through the following basic steps to estimate the energy savings associated with each of the mechanisms mentioned above.

Estimate population size.

- Analyze program records to categorize Allied Partners as U&G agencies.

For a selection of Allied Partners—U&Gs:

- Estimate the number of customers served through programs by the type of practices promoted.

For savings from incremental program promotions:

- Use information from the assessment on each selected organization, combined with energy use and savings fractions from the *Market Assessment*, to estimate energy savings due to program-induced installation of energy-efficient motors or VSDs and induced replacement of failed by each organization. Then sum the site level results to estimate savings due to efficient motor sales by the selected organizations.

Project the results to the population.

Ninety-five percent of the U&G selection indicated that they used Motor Challenge tools and information to develop or promote their programs. Table 4-4 displays key intermediate results in this estimating process. The following paragraphs detail the findings and describe utility response to the program.

Estimating Net Savings from Energy-Efficient Motor Programs for Selected Establishments

Selected Group Size. From a population of 96 U&Gs, 11 Utilities, and 8 Government agencies and associations were reached. Two additional Allied Partners were interviewed, but were dropped from the selection due to incomplete information. The analysis of program effects on one industry association, Electrical Apparatus Service Association, was handled separately. It is discussed in a separate section below.

Table 4-4
Summary of Energy Savings Estimates
for Allied Partner U&G

	Premium-Efficiency Motors	VSDs	Replace versus Repair of Failed Motors
Estimated Population (N)			
Number of U&G Sites	95	95	95
User Savings (n = 19)			
Number of End users Touched by Program	2,427	1,802	1,592
% of group that changed practices due to MC	*58%*	*26%*	*11%*
Incremental Number of End users Influenced	1,332	1,335	165
Energy savings associated with program-induced actions	5,536 MWh/year	12,441 MWh/year	263 MWh/year
Population Results			
Net Savings	27,679 MWh/year	62,203 MWh/year	1,317 MWh/year
Total for all measures			***91,199 MWh/year****

* This does not include adjustment for effects of distributing copies of MM+ directly to customers. The total including the effects of MM+ distribution is 93,840 MWh/year.

Types of equipment, maintenance practices, and design practices promoted. The questionnaire contained a series of items that probed U&Gs program offerings. The key findings from this are:

- 95 percent offered incentives for purchase of energy-efficient motors.
- 53 percent addressed replacement versus rewinding of failed motors through education and incentives.
- 63 percent offered incentives for installation of VSDs.
- 32 percent provided technical assistance and incentives for design of energy-efficient motor systems.
- 32 percent addressed implementation of maintenance procedures.

Use of Motor Challenge tools or materials in conducting programs. The questionnaire contained a series of items that probed U&Gs use of Motor Challenge materials. The key findings from this are:

- 79 percent had used MotorMaster+ software.
- 53 percent had used training modules or services.
- 74 percent had used technical publications.

Effect of MotorMaster+ on available services. The questionnaire contained a series of items that probed U&Gs use of MotorMaster+. The key findings are as follows:

- 47 percent had used to support design of programs.
- 63 percent had used to support delivery of technical services or rebate programs.

- 89 percent had distributed directly to customers.

Estimate of the number of program participants served by selected establishments. U&Gs were asked how customers were served through their programs. According to responses from the 19 U&Gs, together they served the following number of end users:

- Purchase of energy-efficient motors—2,427 customers.
- Installation of VSDs—1,802 customers.
- Replacement versus rewinding of failed motors—1,592 customers.

Estimate of the number of program participants served due to Motor Challenge tools and information and associated energy savings. To estimate energy savings for the group due to program participation, we applied the results of the questions concerning the influence of Motor Challenge information on the design and delivery of programs and services to estimates of energy savings associated with program activities reported by the selected organizations. This process produced an estimate of the number of participants that were involved in programs that used Motor Challenge information to support each component as follows:

- Purchase of energy-efficient motors—1,332 customers.
- Installation of VSDs—1,335 customers.
- Replacement versus rewinding of failed motors—165 customers.

Energy Savings. We then applied the appropriate energy use and energy savings factors to these "net participants" at each site and summed the energy savings over all selected sites. The energy savings from promotion of high efficiency motors, VSDs, and replacement versus repair of failed motors attributable to the Motor Challenge program for the Allied Partner U&Gs was calculated based on estimating the number of end users served due to the influence of Motor Challenge program information or materials shown in formula 4.5.

$$savings = \sum_{sample} number\ served \times use\ factor \times applicability \times implement \times savings\ fraction \quad [4.5]$$

The total savings for the Motor Challenge-related programs operated by the selected organizations were 18,240 MWh per year:

- Purchase of energy-efficient motors—5,536 MWh/year.
- Installation of VSDs—12,441 MWh/year.
- Replacement versus rewinding of failed motors—263 MWh/year.

Projection of Findings to Population

We used formula 4.6 to project savings achieved by the selected organizations to the population of U&Gs that participated as Allied Partners in the Motor Challenge program.

$$Total\ \ program\ savings = \sum_i \left(\frac{N_i}{n_i} \times savings \right) \quad [4.6]$$

Based on extrapolating the results from the selected Allied Partner U&Gs, it was estimated that the 18,769 MWh/year of savings from the group represented a total of 93,840 MWh/year that the entire population provided for the Motor Challenge program. This includes the effects of distributing 1,618 copies of MotorMaster+ directly to their customers. Assuming the average industrial electricity price of

$0.048/kWh, these savings are valued at $4,504,340 per year. Over the useful life of the motors, the discounted value of these savings is $24,030,320.

4.3 Training Programs

4.3.1 Population and Group Selection

Overview of training session attendance. Between September 1996 and October 1999, Motor Challenge conducted or co-sponsored 129 training sessions on motors, pumps, and drives. Over 4,500 individuals representing 2,900 separate establishments attended these training sessions. Attendees included representatives of commercial and industrial end users, vendors, consulting firms, utilities, and government agencies. MACRO International maintained basic information about each section, including the date, location, host, co-sponsors, and number of individuals attending. A detailed summary by year and topic is available in Section 3 Table 3-9.

Selected group and distribution of attendees by type. As discussed in Section 3, lists of attendees were available only for a small subset of these training sessions, encompassing 546 attendees at pump system efficiency and ASD workshops. Our first task was to sort these lists by type of organization (end-user v. vendor or other type of ally), thereby creating the selection group for assessments of training session attendees. The results of this process are repeated here in Table 4-5.

As discussed in Section 1, the mechanisms by which vendors and end users realize energy savings and the methods for estimating those savings are quite different. Therefore, different questionnaires were developed and administered to portions of each group. In projecting the selection group results to the population, we used the ratios of vendors to end users, as well as the ratios of individual attendees to unique establishments shown in Table 4-5. Lists of individual attendees were not available for the MotorMaster+, motor system efficiency, and motor management sessions. We believe that we picked up savings attributable to the MotorMaster+ training sessions by assessing a group of registered users. The other two sessions had relatively few attendees. Therefore, we do not believe that the results below significantly underestimate the savings associated with the Motor Challenge training initiatives as a whole.

Table 4-5
Breakdown of Available Training Attendance Records

	Attendees		Unique Establishments	
	Number	% of Total	Number	% of Total
ASD Training: End users	83	44%	68	50%
ASD Training: Vendors	105	56%	68	50%
Pump Systems: End users	249	71%	139	69%
Pump Systems: Vendors	101	29%	62	31%

4.3.2 Non-End-User Energy Savings: ASD Training

Estimate of number of ASD systems installed by selected establishments. Ten non-end users were assessed from the list of ASD training attendees. They were questioned regarding their prior experience

with ASDs,as well as application of information gained through the training session they attended. The 10 vendors and others that were interviewed stated that they sold or specified 1,897 ASDs per year—an average of 19 systems per vendor—prior to the workshop.

Estimate of number of ASD installations by selected establishments as a result of the training sessions. Sixty percent of the non-end users indicated that they had sold or specified ASD applications since the workshop. A large percentage of the non-end users, compared to the end users, indicated that they were able to sell or specify more ASD applications as a result of the workshops. This translated into 19 percent of the systems that they sold during the period evaluated.

Energy savings. Applying appropriate energy use and energy savings factors to the "net number of ASDs sold" by each supplier and summed over the selected sites results in the estimated energy savings as shown in formula 4.7.

$$savings_{ASD} = \sum_{sample} number\ ASDs \times use\ factor_{type/size\,bin} \times savings\ fraction \qquad [4.7]$$

The total savings were 3,543 MWh/year.

4.3.3 Non-End-User Energy Savings: Pump Training

Estimate of number of pump systems installed or improved by selected establishments. Four vendors were assessed from the list of pump system training attendees. The vendors were questioned regarding their application of information gained through the training session they attended. Fifty percent of them were able to promote pump efficiency as a result of the workshops.

Estimate of number of pump systems installed or improved by selected establishments as a result of the training sessions. Based on the responses as to the ability to specify or sell a higher volume of energy-efficient pumps and related services, it was determined that 17 systems were upgraded as a result of the Motor Challenge program.

Energy savings. Applying appropriate energy use and energy savings factors to the "net number of improved pump systems" at each site and summed over the selected sites results in the estimated energy savings as shown in formula 4.8.

$$savings_{pump} = \sum_{sample} number\ pump\ systems \times use\ factor_{type/size\,bin} \times savings\ fraction \qquad [4.8]$$

Assuming the following savings factors based on the type of improvement:

- Speed controls—30 percent.
- Parallel pumps or downsizing—20 percent.
- Increase pump diameter or other—10 percent.
- Operation & maintenance—2 percent.

The total savings for the group were 311 MWh/year.

4.3.4 Projection of Findings to Population

We used methods summarized in equation 4.9 to extrapolate findings on savings attributable to the training sessions to the population of vendors who attended.

The results of ASD and pump system training attendees were extrapolated as:

$$Total\ \ program\ savings = \sum_{sample}\left(\frac{N_{ASD}}{n_{ASD}} \times savings_{ASD} + \frac{N_{pump}}{n_{pump}} \times savings_{pump}\right) \qquad [4.9]$$

Using formula 4.9, it was estimated that the 3,543 MWh/year of ASD non-end-user savings and the 311 MWh/year of pump system non-end-user savings provided the Motor Challenge program with 147,155 MWh/year of savings. Assuming the average industrial electricity price of $0.048/kWh, these savings are valued at $7,063,439 per year. Over the useful life of the motors, the discounted value of these savings is $37,682,928.

4.4 EASA and AFE

As discussed above, the methodology for estimating the energy savings attributable to Motor Challenge as a result of the Allied Partnerships depended on the type of services provided. The Allied Partners were grouped into those with direct commercial contact to end users and those with no specific product or service who work to influence the behavior of end users and vendors. Those partners who distribute and supply end users with motor systems were queried regarding the quantities of premium efficiency motors, VSDs, and replacement motors that they specified or sold. The other group of Allied Partners, those that do not sell specific products or services, were queried regarding the types of programs and education opportunities offered and the number of participants. In classifying the list of Allied Partners, we included the following kinds of organizations into the category referred to as Utilities & Government:

- Utility Companies
- Government Agencies
- Research Organizations
- Technical Associations
- Trade Associations
- Other.

Analysis of the selection of Allied Partners that were interviewed in this category indicated that two of the Partners did not fit neatly into the evaluation methodology. In order to capture the savings more appropriately, the analysis for Electrical Apparatus Service Association (EASA) and Association of Facility Engineers (AFE) were handled separately.

4.4.1 Population Frame—EASA

EASA is an industry association of businesses that repair and service electrical equipment, including motors. EASA was selected as part of the selection of U&G Allied Partners to be interviewed for this analysis. The assessment found that EASA as an Allied Partner has provided Motor Challenge materials to all of its 3,000 members. We had not made provisions in the research plan to account for such a large number of vendors related to one registered Allied Partner. This posed an interesting question as to how to assess the impact of the program on association members. The association reported what they had done, but could not tell us what its members had implemented.

For this analysis, we were interested in the 2,000 domestic members (1,000 members are international). Additional research to clarify some of the assessment responses revealed that a number of the selected V&Cs were also members of EASA. As a result, it was decided that to avoid double counting, the two types of EASA members would be handled separately—those that were Allied Partners would remain in the V&C analysis, and the other "non-AP" members would be handled as a separate population.

It was estimated that 52 of the V&C Allied Partners were members of EASA, given that 10 of the 14 assessed were EASA members. The remaining 1,948 members were covered by this analysis.

4.4.2 Estimation of Program Net Savings—EASA

Impacts from the V&C Allied Partners were adjusted to appropriately reflect the remaining EASA population frame. The following assumptions were made to adjust the unit impacts:

- EASA V&C Allied Partners are significantly larger than the average EASA members:
  - V&C EASA members employ an average of 112 people (based on D&B information)
  - according to EASA, the average member has 15 employees
  - the remaining 1,948 members employ approximately 12 people.
- Assumed Motor Challenge affected those members selling efficiency equipment rather than improved maintenance practices—25 percent of members revenue is due to sales.
- V&C impacts from sales of premium motors and VSDs were adjusted to reflect smaller shops.

The unit impacts were assumed to be approximately 11 percent of the impacts found for those members who were Allied Partners, and they applied to 25 percent of the members who sold or distributed motor systems. Based on these assumptions, it was estimated that EASA provides the program with 23,325 MWh/year of savings.

4.4.3 AFE

Our research found that the California chapter of AFE as an Allied Partner has actively promoted the Motor Challenge program to its 200 members. The methodology incorporated in the U&G analysis calculated savings based on either the number of program participants or the number of copies of MotorMaster+ distributed. As an association, AFE does not run any specific motor programs, and therefore savings based on program participation by member firms was not applicable. Based on the assessment response, the 75 copies of MotorMaster+ that were distributed through training sessions were included in the portion of the group to be weighted up to the population. As AFE heavily promoted the Motor Challenge program, it was assumed that the remaining 125 members were also likely to have implemented improvements, but statistically it would not have been appropriate to include these savings in the expansion to the U&G population. As such, using adjusted MotorMaster+ results, an estimated 218 MWh/year of savings was calculated separately for these members.

Section 5
Conclusions And Recommendations

In assessing the accomplishments of the Motor Challenge program, it is important to place the energy-saving results discussed in Sections 3 and 4 into the broader context. In the first part of this section, we assess the results of the program from a number of perspectives. Specifically, we:

- Estimate the benefit/cost ratio of the program and compare its cost-effectiveness to that of motor system efficiency programs operated by utilities and other organizations.
- Estimate the breadth of the program's reach; that is, estimate the percentage of total industrial motor system energy represented by end users who have participated in the program and identify what segments of the market they represent.
- Estimate the extent to which participating end users have achieved potential energy savings in their facilities.
- Assess the usefulness of the program resources developed so far in reaching the ultimate goals of Motor Challenge.

In the second part of this section, we make recommendations regarding the operation of the program that, we believe, will enhance its effectiveness.

5.1 Key Evaluation Results in Context

5.1.1 Cost-Effectiveness

The Motor Challenge program has proven to be highly cost-effective in motivating and enabling customers to improve the energy efficiency of the motor systems they purchase, as well in supporting the specification and sale of energy-efficient motor systems by vendors and engineers.
Table 5-1 shows the annual energy savings associated with various components of the program, the discounted lifetime value of these savings, and the total cost of the program. When the full societal costs of the program are taken into account, including the costs incurred by end users for purchasing energy-efficient equipment in response to the program, the benefit/cost ratio for the program is 1.28. That is, the energy savings over the life of the measures installed due the program exceed all costs of the program, including expenses borne by customers to install efficiency measures, by 28 percent. If we compare the value of energy savings only to the amount of federal budget outlays required to achieve them, the benefit/cost ratio for the program increases to 4.55. These cost effectiveness indices match or exceed similar measures for utility-sponsored programs aimed at increasing motor system efficiency.

- ***Conservative accounting of energy savings.*** As discussed in Sections 3 and 4, we only counted energy savings for populations of program users whom we could clearly identify. Thus, for example, we did not count savings attributable to the actions of motor system vendors who used MotorMaster+ and other materials, but who did not register as Allied Partners or through the training workshops. Also, we attempted to avoid possible double counting of benefits achieved by end users who were exposed to two or more program elements.

- ***No monetary value assigned to environmental and productivity benefits.*** The environmental benefits of energy efficiency are well documented. They include reductions in atmospheric pollutants and greenhouse gas emissions. Many of the energy efficiency measures advanced by the Motor Challenge program also contributed to increases in the overall productivity of labor and capital. These benefits included increased control over manufacturing processes through the use of adjustable speed drives, which turn leads to reduced waste and improved throughput. Other non-energy benefits

documented through the Showcase Demonstration projects included reduced labor costs, reduced downtime, extended equipment life, and avoidance of costly capital replacement or expansion projects through more efficient use of existing resources. In cases where these benefits were quantified, they ranged from $18,000 per year to over $100,000 per year.

Table 5-1
Summary of Motor Challenge Benefits, Costs, and Cost-Effectiveness

	Annual Program Benefits		Measure Lifetime Benefits	
Program Component	**MWh/Year**	**$ Savings/Year**	**MWh**	**NPV of Savings**
End users				
MM+	50,687	$2,432,971	405,495	$12,979,723
ASD Training	22,475	$1,078,779	179,797	$5,755,209
Pump Training	30,829	$1,479,797	246,633	$7,894,605
Showcase	24,148	$1,105,600	193,184	$5,898,296
Energy Matters	35,173	$1,688,305	281,384	$9,006,984
Teleconference	4,227	$202,912	33,819	$1,082,522
End users Subtotal	*167,539*	*$7,988,365*	*1,340,311*	*$42,617,339*
Allied Partners				
V & C	88,352	$4,240,872	706,812	$22,624,741
U & G	93,840	$4,504,340	750,723	$24,030,320
EASA	23,325	$1,119,594	186,599	$5,972,949
AFE	218	$10,460	1,743	$55,803
ASD Training	131,431	$6,308,695	1,051,449	$33,656,422
Pump Training	15,724	$754,744	125,791	$4,026,506
Non End-users Subtotal	*352,890*	*$16,938,705*	*2,823,118*	*$90,366,741*
Total Energy Benefits	***520,429***	***$24,927,070***	***4,163,429***	***$132,984,080***
Program Costs				
Program Administration				$ 29,200,000
Customer Investments Energy Efficiency Measures				$ 74,781,211
Total Program Costs				***$ 103,981,211***
Benefit/Cost Tests				
Federal Benefit/Cost Ratio				***4.55***
Utility-type Program Cost Test				***1.28***

We used very conservative assumptions and procedures in preparing the benefit/cost analysis. The following were key elements of the framework and inputs.

- ***High discount rate.*** In keeping with the high implicit discount rate that end users apply to energy savings, we estimated the net present value of program-related energy savings using a 10 percent discount. By way of comparison, the Environmental Protection Agency uses a 4 percent discount rate in forecasting the net present value of energy savings generated by its ENERGY STAR® programs for

purposes of program planning. If we had applied a 4 percent discount rate instead of the 10 percent rate, the present value of program-related energy savings would have been estimated at $168 million, with a benefit/cost ratio of 1.61 for all costs; 5.75 for program costs only.

Comparison to utility rebate programs. Based on the analysis described above, we conclude that Motor Challenge has been *very* cost effective, especially in comparison to utility-sponsored rebate programs designed to stimulate the market for efficient motors and related equipment. Since the enactment of the 1997 Federal motor efficiency (EPAct) standards, such programs have experienced difficulties in meeting cost-effectiveness standards, due primarily to the relatively low unit savings available from upgrading motor efficiency from EPAct to so-called premium standards. One such program sponsored by utilities in the Northwest suspended operations due to problems in meeting cost-effectiveness criteria.

5.1.2 Breadth of Program Reach

Over the six-year life of the program, Motor Challenge has established communication channels with technical and management decision-makers who represent a large portion of U. S. motor system purchases and energy consumption.

As of September 1999, there were 5,655 *registered* MotorMaster+ users representing 3,664 unique end-user facilities. On average, the registered MotorMaster+ users are large industrial facilities. XENERGY estimated that they use roughly 20 times as much motor system energy as the average manufacturing plant and 5 times as much as a typical utility-sponsored motor program participant. Altogether, we estimated that the population of registered MotorMaster+ users consumed 165,120 GWh/year in electricity versus 1.1 million GWh/year for industrial users as a whole. Thus, even though registered MotorMaster+ users represent less than 1 percent of all industrial facilities, they account for 15.2 percent of total industrial electricity use and a comparable portion of motor system energy. Therefore, at a minimum, Motor Challenge has identified technical and management personnel in 3,664 facilities that account for 15.2 percent of total industrial motor system energy use, or roughly 103,000 GWh per year. In addition to these end users, the program has identified potential decision-makers in 2,000 to 4,000 facilities through its Information Clearinghouse and training activities. The customer identification records that support these operations are a key resource in advancing the mission of the program.

5.1.3 Extent of Potential Savings Captured in Participant Facilities

Participating end users captured a large portion of energy savings available from motor efficiency upgrades through actions attributable to the program—about 9 percent of the potential annual savings in their facilities.

The *Market Assessment* identifies and quantifies two basic groups of motor system efficiency improvements. The first consists of improvements to the inherent efficiency of motors themselves; the second consists of improving the way in which the components of a given motor system work together to accomplish the designated task. The first group of measures includes upgrading the efficiency of failed motors, replacing rather than rewinding failed motors, and improving rewind practices. The *Market Assessment* estimated the potential savings from such measures at 4.3 percent of total motor system energy use. In the following paragraphs we estimate how participants in the program captured much of these potential savings.

The evaluation found that many Motor Challenge participants are already following good practices in efficient motor purchase decisions. Still, among registered MotorMaster+ users interviewed for the evaluation, 18 percent reported that they implemented changes to motor system design, purchase, and maintenance practices that would not have been made in the absence of the program.

Roughly one-eighth (12.5 percent) of the stock comes up for replacement each year. Thus, for the MotorMaster+ users interviewed for this study, potential savings from motor efficiency upgrades amount to:

$$\begin{aligned} \textit{Potential Savings} &= \textit{12.5\% stock turnover} \times \textit{4.3\% potential savings} \times \textit{103,300 GWh/year} \\ &= \textit{555.2 GWh/year} \end{aligned}$$

MotorMaster+ users attributed actions that led to 49 to 51 GWh per year in motor-efficiency upgrade savings to the influence of the program. This is 9 percent of the potential savings identified in the above equation. These actions included purchasing more premium efficiency motors than they would have in the absence of the program and rewinding 2.5 percent fewer motors than they would have in the absence of the program.

These results can also be understood in the context of the industrial market for motors. MotorMaster+ users attributed the purchase of an estimated 10,303 premium efficient motors to the influence of the program (instead of purchasing EPAct qualifying motors). This is roughly 6 percent of the number of units of all premium efficient motors sold in 1998 to the industrial sector.

Motor Challenge has barely scratched the surface in helping end users realize potential energy savings from system-level improvements, such as implementation of new control strategies or optimization of compressed air system operations.

Between MotorMaster+ users, training session attendees, and users of various information services, Motor Challenge has reached 6,000 to 8,000 end-user facilities directly. Using the results of the *Market Assessment* and the evaluation assessments, we estimate that these facilities used approximately 200,000 GWh per year in motor system energy. The *Market Assessment* found that industrial facilities can save, on average, 10.5 percent of total motor system energy usage through system-level measures.[1] Thus, for the population of end users directly served by the program, potential savings from system-level measures can be estimated at 21,000 GWh per year. Our best estimate is that these facilities captured at most 323 GWh per year in system-level improvement savings, or 1.5 percent of the available potential.

This finding does not imply that Motor Challenge efforts to stimulate changes in end-user practices have been ineffective. On the contrary, we found that 24 percent of end users who participated in the ASD training program and 48 percent of those who participated in the Pump System training program reported that they implemented improvements to the efficiency of their systems that they would not have made in the absence of the program. Similarly, a survey of end users who received the *Energy Matters* newsletter found that one-third reported that they had made changes in the way they purchased or managed motor systems as a result of reading the newsletter.

5.1.4 Motor Challenge Impacts on the Supply Side of the Market

Allied Partners (vendors and consultants) who participated in the program reported that Motor Challenge tools were useful in convincing customers to purchase efficient motors and to implement other motor system efficiency measures. However, the Allied Partner reached relatively few firms using its early strategy of recruiting individual firms. More recent approaches to trade and industry associations are more likely to support broader dissemination and use of Motor Challenge tools on the supply side of the market.

- ***Recruitment results.*** As of September 1999, only 104 equipment vendors and consultants had been recruited as Allied Partners. By way of contrast, the structuring of a relationship with the Electrical Apparatus Service Association (EASA) created channels to over 1900 domestic motor dealer and service shops.

[1] The *Market Assessment* identified total potential motor system efficiency savings of 14.8 ~ 15 percent of baseline energy usage. Improvements to motor system design and operation, such as adding new controls to compressed air systems or matching pump sizes to measured load, account for 10.5 percent of savings from the baseline. Improvements to the inherent efficiency of motors themselves accounts for the remaining potential.

- ***Use of Motor Challenge tools or materials by Vendors & Consultants.*** Ninety percent of the sampled vendor and consultant Allied Partners had used MotorMaster+ software. Of the V&Cs that used MotorMaster+, 73 percent used it to help customers with motor selection and 39 percent to assist in replace v. repair decisions.

5.2 Lessons Learned and Conclusions

With 6 years of experience in developing the Motor Challenge program, there have been many valuable lessons learned.

- Motor Challenge has already established extensive and effective channels to personnel in end-user facilities and through a large number of key Allied Partner vendors. However, the majority of the potential savings in end-user facilities have not been achieved. The next major effort must be to develop a set of tools and materials that will support end users and vendors in achieving system-level savings.
- Program record keeping must be enhanced to enable managers and implementation staff to better characterize establishments quickly as to function (end-user v. vendor v. utility or trade association), industry, and size. This will aid in program marketing, client relations management, and evaluation.
- Leveraging the market is essential to maximizing the effect of any national market transformation program, such as Motor Challenge and now BestPractices, for DOE. Suppliers must see motivational factors to joining and promoting an energy-efficiency program. This win-win situation needs to be developed and leveraged.
- Tools need to be made simple and developed for decision-making at various stages of project implementation: general plant profiling, screening for technology opportunities, and implementation of projects. Consideration of time to be spent, or not spent, by different participants in energy efficiency project implementation should be respected when developing tools.
- Programs should develop activities for not only awareness and promotion, but also for implementation in partnership with industry on a plant level. More extensive resources are needed to assist Allied Partners to more easily convince and assist end users in project implementation.
- Working on a plant-by-plant basis to demonstrate the leading plants in implementing best management practices for motor-driven systems (motor, pumps, compressed air systems) will go a long way in encouraging other companies to accelerate energy-efficiency initiatives—industry has a tendency to follow leaders.

Appendix A

Motor Challenge Evaluation
Utilities and Government Agencies

Name	**Phone**
Title	**Fax**
Company	**e-mail**
Street Address	
City	**Interviewer**
State	**Call dates**
ZIP	**Complete Date**

Introduction: Hello, my name is _____ with XENERGY CONSULTING. I am calling on behalf of the U. S. Department of Energy regarding the Motor Challenge program.

LEAD-IN FOR ALLIED PARTNERS: I would like to ask a few questions about your organization's activities as an Allied Partner in Motor Challenge. May I please speak with [CONTACT NAME]. IF CONTACT IS NOT AVAILABLE, ESTABLISH TIME FOR CALL BACK. IF CONTACT IS NO LONGER AT THE FACILITY, ASK IF THE CONTACT HAS BEEN TRANSFERRED ELSEWHERE IN THE COMPANY. IF THE CONTACT NO LONGER WORKS FOR THE COMPANY, ASK: May I speak with the person in your organization who is most knowledgeable about your activities related to Motor Challenge?

Lead-in for respondent: Thank you for taking the time to answer a few questions about your organization's activities as an Allied Partner in the Motor Challenge program. The information you provide will be used to aid in improving the program. All answers will be kept strictly confidential.

LEAD-IN FOR RESPONDENTS WHO ARE NOT ALLIED PARTNERS. I would like to ask a few questions about your organization's use of materials and services provided by the Motor Challenge program. May I please speak with [CONTACT NAME]. IF CONTACT IS NOT AVAILABLE, ESTABLISH TIME FOR CALL BACK. IF CONTACT IS NO LONGER AT THE FACILITY, ASK IF THE CONTACT HAS BEEN TRANSFERRED ELSEWHERE IN THE COMPANY. IF THE CONTACT NO LONGER WORKS FOR THE COMPANY OR SAMPLE LIST DOES NOT CONTAIN CONTACT NAME, ASK: May I speak with the person in your organization who is most knowledgeable about your activities related to electric motors and motor system efficiency?

Lead-in for respondent: Thank you for taking the time to answer a few questions about your organization's use of Motor Challenge program materials and services. The information you provide will be used to aid in improving the program. All answers will be kept strictly confidential.

General AP Questions

IF RESPONDENT IS AN ALLIED PARTNER, ASK THIS SEQUENCE, ELSE SKIP TO NA1.

AP1. When did your company enroll as an Allied Partner?

_____(Year)

AP2. Why did your company enroll in the program?

Increase sales 1
Complements our business strategy 2
Complements our organizational mission 3
Helps differentiate us from competitors 4
Helps us provide value-added products and services to customers 5
Have unbiased validation of energy efficient technology 6
Be on the cutting edge of technology 7
Other_____ 8

AP3. Generally speaking, has your experience as a Motor Challenge Allied Partner met your needs and objectives? PROBE WHY/WHY NOT?

_____
_____
_____
_____

AP4. Do you have any suggestions about how the program might be changed so that it better met your needs and objectives?

_____
_____

General Questions

ADMINISTER NA SEQUENCE TO ALL RESPONDENTS

NA1. How did your company learn about the Motor Challenge / Allied Partner program?

Directly from DOE or contractor to DOE 1
Supplier / Vendor 2
Customer 3

Industry trade group 4
Industry publication 5
Conference 6
Other_____ 7

NA2. Has your company used any Motor Challenge tools or materials in serving its customers? IF YES, Which ones?

MotorMaster+ software 1
Training modules or services 2
Technical publications 3
Other (Specify) 4

Program History

PR1. Over the past 5 years, has your company/agency operated any programs or undertaken other activities to promote motor system efficiency measures, including the purchase of energy efficient electric motors?

Yes 1
No 2

IF YES ASK PR2. IF NO, SKIP TO MM1.

PR2. When did these programs begin? When did they end – or are they still underway?

_____ Date Began
_____ Date Ended or still underway

PR3. Which types of equipment, maintenance practices, or design practices did the programs promote?

Purchase of energy efficient motors 1
Replacement versus rewinding of failed motors 2
Installation of VSDs 3
Installation of other kinds of efficient motor systems
(Specify)_____ 4
Design of energy efficient motor systems 5
Implementation of maintenance procedures 6
Other _____ 7

PR4. What kinds of services or incentives did your organizations offer to promote motor system efficiency measures?

Rebates to customers 1
Rebates to vendors 2
Engineering or design technical assistance 3
Funding of engineering studies 4
End-user or vendor training 5
Dissemination of technical information 6
Other _____ 7

PR5. Roughly how many customers were served through these programs?

_____

PR6. How were these customers distributed between commercial and industrial establishments? Large (500+ employees) and small establishments? Among major industries?

_____
_____
_____
_____

PR7. FOR REBATE PROGRAMS: Do you have a sense of the number of motors or other pieces of equipment rebated through the program?

_____

PR8. Was the program(s) evaluated? IF YES: What were the total savings for the program? Savings per unit? Is a copy of the evaluation report publicly available? IF YES, ASK TO HAVE IT SENT.

_____
_____

PR9. Has your organization used any Motor Challenge tools or materials in conducting the program? IF YES, Which ones?

MotorMaster+ software..... 1
Training modules or services 2
Technical publications..... 3
Other (Specify)..... 4

IF USED MotorMaster+, ASK Qs. MM1 TO MM13.

Motor Master

MM1. Have you used the MotorMaster+ software package to...

Support design of programs or services to customers:
e.g. analysis to set rebate levels..... 1
Support delivery of technical services or rebate programs 2
Distribute directly to customers for their own use 3

IF MotorMaster+ USED FOR PROGRAM DESIGN ASK NEXT SEQUENCE, OTHERWISE SKIP TO MM5.

MM2. What tasks did you use MotorMaster+ for in program design?

_____
_____

MM3. If MotorMaster+ had ***not*** been available, how likely is it that your organization would have developed the information and analytic capabilities needed to select and analyze the cost-effectiveness of various motor models?

_____
_____

MM4. Do you think you would have changed the design of the program if MotorMaster+ had not been available? What features would have been different?

_____
_____
_____
_____

IF MotorMaster+ USED TO SUPPORT PROGRAM DELIVERY ASK NEXT SEQUENCE, OTHERWISE SKIP TO MM11

MM5. How did you use MotorMaster+ in the course of delivering the program to customers or dealers?

_____
_____
_____
_____

MM6 Has using MotorMaster+ helped your organization convince customers to purchase energy efficient motors and/or dealers to promote energy efficient motors? PROBE REASONS FOR WHY OR WHY NOT. PROBE FOR EXAMPLES.

_____
_____
_____
_____

MM6a. Has using MotorMaster+ helped your organization convince customers to replace motors instead of rewinding them upon burnout? PROBE REASONS FOR WHY OR WHY NOT. PROBE FOR EXAMPLES.

_____
_____
_____
_____

MM7 **IF YES TO MM7a**. Would you say that the energy savings and cost-effectiveness calculations supported by MotorMaster+ were a deciding factor for some of your customers who purchased energy-efficient motors?

Yes..... 1
No..... 2
Don't know..... 3

MM7a **IF YES TO MM8.** Roughly speaking, for what percentage of customers you served were those calculations decisive?

_____%

MM8 Relative to other services and incentives offered by your program, how important was MotorMaster+ in encouraging customers to purchase (dealers to promote) energy-efficient motors? PROBE REASONS.

_____
_____
_____
_____

MM9 Can you suggest any changes to the MotorMaster+ software that would improve its ability to support your programs or other energy efficiency activities?

_____
_____
_____
_____

IF MotorMaster+ DISTRIBUTED DIRECTLY TO END-USE CUSTOMERS, ASK THE NEXT SEQUENCE, OTHERWISE SKIP.

MM10 Roughly how many copies of MotorMaster+ did your organization distribute?

_____

MM11 Typically, what kind of customer requested or received the package? PROBE LARGE/SMALL, INDUSTRY TYPE, JOB DESCRIPTION OF THE USER.

_____
_____

MM12 Have you received any feedback from customers regarding their use of MotorMaster+?

Yes..... 1
No..... 2

IF YES ASK MM14, ELSE SKIP TO TR1.

MM13 Can you suggest any changes to the MotorMaster+ software that would make it more useful for customers? ...more effective in convincing customers to purchase energy-efficient motors?

_____
_____
_____
_____

Training

IF RESPONDENT REPORTS USING TRAINING MODULES OR SERVICES, ASK SEQUENCE, OTHERWISE SKIP.

TR1. ***What type*** of Motor Challenge-related workshops or training did your organization sponsor?
MotorMaster+
ASD / ASDMaster
Motor Systems
Managing Electric Motors
Pump Systems
Water / Wastewater
Steam Efficiency
Other_____

TR2 ***How many*** ... workshops / training sessions has your organization sponsored?
MotorMaster+ _____
ASD / ASDMaster _____
Motor Systems _____
Managing Electric Motors _____
Pump Systems _____
Water / Wastewater _____
Steam Efficiency _____
Other_____

TR3 Which of the following Motor Challenge materials or services did you use in developing these training sessions?

Published training modules administered by own staff 1
Motor Challenge staff or contractors on site..... 2
Other _____ Specify..... 3

TR4 Roughly, ***when*** were the ... workshops / training sessions held?
_____
_____

TR5. About how many different customers have taken a ... workshop / training session that your organization sponsored?

MotorMaster+ _____
ASD / ASDMaster _____
Motor Systems _____
Managing Electric Motors _____
Pump Systems _____
Water / Wastewater _____
Steam Efficiency _____
Other_____

TR6. Have you gotten feedback from training session participants regarding their use of materials, concepts, or skills learned in the sessions? IF YES: Please describe.

_____
_____
_____
_____

TR7. Do you have any suggestions about the training materials or services that would make them more useful to your customers or constituents? IF YES: Please describe.

_____
_____
_____
_____

General Questions about Market

GM1 Over the past two years, would you say that awareness of motor system efficiency issues among industrial energy users has increased, decreased, or stayed about the same?

Increased..... 1
Decreased 2
Stayed about the same 3
Don't know..... 4

GM2 How about awareness of motor system efficiency issues among vendors, designers, and engineers?

Increased..... 1
Decreased 2
Stayed about the same 3
Don't know..... 4

GM3 And how about implementation of motor system efficiency measures and designs?

Increased..... 1
Decreased 2
Stayed about the same 3
Don't know..... 4

IF ANY CHANGES ARE NOTED IN THE QUESTIONS GM1-GM3, ASK

GM4 What do you think are the most important factors that have contributed to these changes? PROBE EPAct, CHANGES IN ECONOMIC CONDITIONS, ENVIRONMENTAL COMPLIANCE REQUIREMENTS, UTILITY PROGRAMS, GOVERNMENT PROGRAMS INCLUDING MOTOR CHALLENGE.

_____
_____

GM5 In what specific ways has Motor Challenge contributed to these changes?

_____
_____
_____
_____

THANK YOU FOR YOUR TIME AND YOUR HELP.

Motor Challenge Evaluation
Vendors and Consultants

Name	**Phone**
Title	**Fax**
Company	**e-mail**
Street Address	
City	**Interviewer**
State	**Call dates**
ZIP	**Complete Date**

Introduction: Hello, my name is _____ with XENERGY CONSULTING. I am calling on behalf of the U. S. Department of Energy regarding the Motor Challenge program.

LEAD-IN FOR ALLIED PARTNERS. I would like to ask you a few questions about your organization's activities as an Allied Partner in Motor Challenge. May I please speak with [CONTACT NAME]. IF CONTACT IS NOT AVAILABLE, ESTABLISH TIME FOR CALL BACK. IF CONTACT IS NO LONGER AT THE FACILITY, ASK IF THE CONTACT HAS BEEN TRANSFERRED ELSEWHERE IN THE COMPANY. IF THE CONTACT NO LONGER WORKS FOR THE COMPANY, ASK: May I speak with the person in your organization who is most knowledgeable about your activities related to Motor Challenge?

Lead-in for respondent: Thank you for taking the time to answer a few questions about your organization's activities as an Allied Partner in the Motor Challenge program. The information you provide will be used to aid in improving the program. All answers will be kept strictly confidential.

LEAD IN FOR VENDORS/CONSULTANTS WHO ARE NOT ALLIED PARTNERS. I would like to ask a few questions about your company's use of materials and services provided by the Motor Challenge program. May I please speak with [CONTACT NAME]. IF CONTACT IS NOT AVAILABLE, ESTABLISH TIME FOR CALL BACK. IF CONTACT IS NO LONGER AT THE FACILITY, ASK IF THE CONTACT HAS BEEN TRANSFERRED ELSEWHERE IN THE COMPANY. IF THE CONTACT NO LONGER WORKS FOR THE COMPANY OR SAMPLE LIST DOES NOT CONTAIN CONTACT NAME, ASK: May I speak with the person in your organization who is most knowledgeable about your activities to promote or sell products and services related to electric motors and motor system efficiency?

Lead-in for respondent: Thank you for taking the time to answer a few questions about your organization's use of Motor Challenge program materials and services. The information you provide will be used to aid in improving the program. All answers will be kept strictly confidential.

Respondent Characterization

RC1 First, can you tell me your job title?

_____

RC2 And what are your major responsibilities in your job?

_____

RC3 Which of the following activities does your company pursue?

Repair or rewind electric motors 1
Distribute electric motors 2
Distribute motor driven equipment **PROBE WHAT KIND** 3
Distribute variable speed drives 4
Provide design engineering services for motor driven equipment 5
Analyze the energy usage of motor-driven systems 6
Design energy efficiency retrofits for motor-driven systems 7
Install electric motors and/or motor-driven equipment 8

IF RESPONDENT DISTRIBUTES ELECTRIC MOTORS ASK RC3a, ELSE SKIP TO RC3c.

RC3a Last year, approximately how many AC electric motors over one HP did you sell?

_____

RC3b Roughly speaking, what was the distribution of these motors between the following horsepower categories?

1-20 HP ..... _____
21-100 HP ..... _____
101-200 HP ..... _____
Over 200 HP ..... _____
[SHOULD TOTAL TO 100%.]

IF RESPONDENT DISTRIBUTES VSDs ASK RC3c, ELSE SKIP TO RC3d.

RC3c Last year, approximately how many variable speed drives did you sell?

_____

IF RESPONDENT DISTRIBUTES OTHER KINDS OF EQUIPMENT, ASK RC3d, ELSE SKIP TO RC3e.

RC3d Last year, approximately how many units of [KINDOF EQUIPMENT] did you sell?

_____

ASK RC3e TO ALL RESPONDENTS.

RC3e What industries are most heavily represented among your customers?

_____

_____

RC4 Is the geographic scale of your company's operations ...

Local 1
Regional 2
National 3
International 4

RC5 And what is the geographic extent of your activities within the company?

Local 1
Regional 2
National 3
International 4

General AP Questions

IF RESPONDENT IS AN ALLIED PARTNER, ASK THIS SEQUENCE, ELSE SKIP TO NA1.

AP1. When did your company enroll as an Allied Partner?

_____(Year)

AP2. Why did your company enroll in the program?

Increase sales 1
Complements our business strategy 2
Complements our organizational mission 3
Helps differentiate us from competitors 4
Helps us provide value-added products and services to customers 5
Have unbiased validation of energy efficient technology 6
Be on the cutting edge of technology 7
Other_____ 8

AP3.. Generally speaking, has your experience as a Motor Challenge Allied Partner met your needs and objectives? PROBE WHY/WHY NOT?

_____
_____
_____
_____

AP4. Do you have any suggestions about how the program might be changed so that it better met your needs and objectives?

_____
_____

General Vendor Questions

ADMINISTER NA SEQUENCE TO ALL VENDORS

NA1. How did your company learn about the Motor Challenge / Allied Partner program?

Directly from DOE or contractor to DOE 1
Supplier / Vendor 2
Customer 3

Industry trade group 4
Industry publication 5
Conference 6
Other_____ 7

NA2. Has your company used any Motor Challenge tools or materials in serving its customers? IF YES, Which ones?

MotorMaster+ software 1
Training modules or services 2
Technical publications 3
Other (Specify) 4

IF USED MotorMaster+, ASK Qs. MM1 TO MM17.

MotorMaster+

MM1. Have you used the MotorMaster+ software package to...

Assist customers in selecting motors for purchase..... 1
Assist customers in making rewind versus replace decisions..... 2
Assist customers in making motor sizing decisions..... 3
Assist customers in developing motor inventories..... 4
Assist customers in developing preventive maintenance routines..... 5
Any other uses (Specify) _____..... 6

IF MM1 = 1 ASK NEXT SEQUENCE, OTHERWISE SKIP.

MM2. What percentage of the AC general-purpose motors that you sold during 1998 exceeded the EPAct standards?

_____%

MM2a What percentage, if any, of these motors motor sales were subsidized by utility-sponsored rebate programs?

_____%

MM2b How did you use MotorMaster+ to convince customers to select premium efficiency motors? PROBE COMPARISON OF LONG-TERM FINANCIAL IMPLICATIONS [LIFE CYCLE COSTS], RELIABILITY, QUALITY.

_____
_____
_____
_____

MM2c Prior to obtaining MotorMaster+, how did you promote energy efficient motors to customers?

_____
_____
_____

MM3 If you had not been able to use MotorMaster+ to illustrate the benefits of using premium efficiency motors, do you think number of those motors sold would have been higher, lower or about the same?

Higher [ASK MM4]..... 1
Lower [ASK MM4]..... 2
About the same [SKIP TO MM6]..... 3
Don't know [SKIP TO MM6]..... 4

MM4 How much higher (lower)? ENTER PERCENT.

_____%

MM5 Why do you say that?

_____
_____
_____
_____

IF MotorMaster+ USED TO SUPPORT SUPPORT REWIND/REPLACE DECISIONS ASK NEXT SEQUENCE, OTHERWISE SKIP

MM6. Has using MotorMaster+ helped your company convince customers to replace motors instead of rewinding them upon burnout? PROBE REASONS FOR WHY OR WHY NOT. PROBE FOR EXAMPLES.

_____
_____
_____
_____

MM6a Prior to obtaining MotorMaster+, how did you promote replacement of failed motors versus rewinding?

_____
_____
_____

IF MM6 = YES, ASK MM7, OTHERWISE SKIP.

MM7 Roughly how many motors did you convince customers to replace instead of rewinding, using information and analysis from MotorMaster+?

_____

MM8 Relative to other services you offer, how important was MotorMaster+ in encouraging customers to purchase (dealers to promote) energy-efficient motors? PROBE REASONS.

_____
_____
_____
_____

MM9 Can you suggest any changes to the MotorMaster+ software that would improve its ability to support your services to customers?

_____
_____
_____
_____

MM10 Have you distributed copies of MotorMaster+ to your customers for their own use?

Yes..... 1
No..... 2
Don't know..... 3

IF YES ASK MM10a-MM13, ELSE SKIP TO TR1.

MM10a Roughly how many copies of MotorMaster+ did your organization distribute?
.....
_____

MM11 Typically, what kind of customer requested or received the package? PROBE LARGE/SMALL, INDUSTRY TYPE, JOB DESCRIPTION OF THE USER.

_____
_____

MM12 Have you received any feedback from customers regarding their use of MotorMaster+?

Yes..... 1
No..... 2

IF YES ASK MM13 ELSE SKIP TO AS1.

MM13 Can you suggest any changes to the MotorMaster+ software that would make it more useful for customers? ...more effective in convincing customers to purchase energy-efficient motors?

_____
_____
_____
_____

IF RESPONDENT REPORTS SELLING VARIABLE OR ADJUSTABLE SPEED DRIVES, ASK NEXT SEQUENCE, ELSE SKIP TO TR1.

AS1. Have you used Motor Challenge materials to help convince customers to purchase Adjustable Speed Drives to reduce motor system energy consumption?

Yes [ASK AS2] 1
No [SKIP TO EQ1] 2
Don't know [SKIP TO EQ1] 3

AS1a How did you use Motor Challenge materials to help convince customers to purchase Adjustable Speed Drives? PROBE COMPARISON OF LONG-TERM FINANCIAL IMPLICATIONS [LIFE CYCLE COSTS], RELIABILITY, QUALITY, INCREASED CONTROL OVER PRODUCTION PROCESSES.

_____
_____
_____
_____

AS1b Prior to obtaining Motor Challenge materials, how did you promote ASDs to customers?

_____
_____
_____

AS2 If you had not been able to use Motor Challenge materials to explain the benefits of using ASDs, do you think your sales of ASD last year would have been higher, lower or about the same?

Higher [ASK AS3] 1
Lower [ASK AS3] 2
About the same [SKIP TO EQ1] 3
Don't know [SKIP TO EQ1] 4

AS3 How much higher (lower)? ENTER PERCENT.

_____%

AS4 Why do you say that?

_____
_____
_____

IF RESPONDENT REPORTS SELLING MOTOR SYSTEM DESIGN OR ENGINEERING SERVICES, ASK NEXT SEQUENCE, ELSE SKIP TO TR1.

EQ1. Have you used Motor Challenge materials to help convince customers to purchase energy efficient motor-driven equipment or services to improve motor system efficiency?

Yes [ASK AS2] 1
No [SKIP TO EQ1] 2
Don't know [SKIP TO EQ1] 3

EQ1a Can you describe these products or services for me?

_____
_____
_____

EQ1b How did you use Motor Challenge materials to help convince customers to purchase these products or services? PROBE COMPARISON OF LONG-TERM FINANCIAL IMPLICATIONS [LIFE CYCLE COSTS], RELIABILITY, QUALITY, INCREASED CONTROL OVER PRODUCTION PROCESSES, ENVIRONMENTAL COMPLIANCE.

_____
_____
_____
_____

EQ1c Prior to obtaining Motor Challenge materials, how did you promote these products or services to customers?

_____
_____
_____

EQ2 If you had not been able to use Motor Challenge materials to explain the benefits of these products or services, do you think your sales of them last year would have been higher, lower or about the same?

Higher [ASK AS3] 1
Lower [ASK AS3] 2
About the same [SKIP TO EQ1] 3
Don't know [SKIP TO EQ1] 4

EQ3 How much higher (lower)? ENTER PERCENT.

_____%

EQ4 Why do you say that?

_____
_____
_____

Training

IF RESPONDENT REPORTS USING TRAINING MODULES OR SERVICES, ASK SEQUENCE, OTHERWISE SKIP.

TR1. What type of Motor Challenge-related workshops or training did your organization sponsor?
MotorMaster+
ASD / ASDMaster
Motor Systems
Managing Electric Motors
Pump Systems
Water / Wastewater
Steam Efficiency
Other_____

TR2 How many ... workshops / training sessions has your organization sponsored?
MotorMaster+ _____
ASD / ASDMaster _____
Motor Systems _____
Managing Electric Motors _____
Pump Systems _____
Water / Wastewater _____
Steam Efficiency _____
Other_____

TR3 Which of the following Motor Challenge materials or services did you use in developing these training sessions?

Published training modules administered by own staff 1
Motor Challenge staff or contractors on site..... 2
Other _____ Specify..... 3

TR4 Roughly, when were the ... workshops / training sessions held?
_____
_____

TR5. About how many different customers have taken a ... workshop / training session that your organization sponsored?

MotorMaster+ _____
ASD / ASDMaster _____
Motor Systems _____
Managing Electric Motors _____
Pump Systems _____
Water / Wastewater _____
Steam Efficiency _____
Other_____

TR6. Have you gotten feedback from training session participants regarding their use of materials, concepts, or skills learned in the sessions? IF YES: Please describe.

_____
_____
_____
_____

TR7. Do you have any suggestions about the training materials or services that would make them more useful to your customers or constituents? IF YES: Please describe.

_____
_____
_____
_____

General Questions about Market

GM1 Over the past two years, would you say that awareness of motor system efficiency issues among industrial energy users has increased, decreased, or stayed about the same?

Increased..... 1
Decreased 2
Stayed about the same 3
Don't know..... 4

GM2 How about awareness of motor system efficiency issues among customers?

Increased..... 1
Decreased 2
Stayed about the same 3
Don't know..... 4

GM3 And how about implementation of motor system efficiency measures and designs?

Increased..... 1
Decreased 2
Stayed about the same 3
Don't know..... 4

IF ANY CHANGES ARE NOTED IN THE QUESTIONS GM1-GM3, ASK

GM4 What do you think are the most important factors that have contributed to these changes? PROBE EPACT, CHANGES IN ECONOMIC CONDITIONS, ENVIRONMENTAL COMPLIANCE REQUIREMENTS, UTILITY PROGRAMS, GOVERNMENT PROGRAMS INCLUDING MOTOR CHALLENGE.

_____

_____

GM5. Over the past two years, has your ability to offer energy efficiency equipment become more important to the competitive position of your business, become less important, or had no influence on your competitive position?

More important..... 1
Less important 2
No effect on competitive position 3
Don't Know..... 4

IF CR5 DOES NOT EQUAL 4 ASK CR6, ELSE END.

GM6a. What is the main reason for the change in importance of energy efficiency as a competitive strategy?

_____

GM6b. Are there other reasons?

_____

	CR2a	CR2b
No other reasons		0
Greater demand among customers.	1	1
Competing firms are offering more efficient equipment or related services	2	2
Utility programs	3	3
Manufacturers are promoting efficient equipment	4	4
Higher profit margins to vendors on energy efficient equipment	5	5
Changes in economic conditions for consumers	6	6
Changes in energy prices	7	7
Other (Specify) _____	8	8
Don't Know	9	9

GM7 In what specific ways has Motor Challenge contributed to these changes?

_____

_____

THANK YOU FOR YOUR TIME AND YOUR HELP.

Motor Challenge Evaluation
End-User Assessment

Name	**Phone**
Title	**Fax**
Company	**e-mail**
Street Address	
City	**Interviewer**
State	**Call dates**
ZIP	**Complete Date**

Introduction: Hello, my name is _____ with [NAME OF ASSESSMENT RESEARCH FIRM]. I am calling on behalf of the U. S. Department of Energy in regard to the Motor Challenge program.

I would like to ask you a few questions about your company's use of products and services developed by the Motor Challenge program. May I please speak with [CONTACT NAME]. IF CONTACT IS NOT AVAILABLE, ESTABLISH TIME FOR CALL BACK. IF CONTACT IS NO LONGER AT THE FACILITY, ASK IF THE CONTACT HAS BEEN TRANSFERRED ELSEWHERE IN THE COMPANY. IF NO CONTACT NAME OR CONTACT NO LONGER WORKS FOR THE COMPANY, ASK: May I speak with the plant manager or maintenance manager?

Lead-in for respondent: Hello, my name is _____ with XENERGY CONSULTING. I am calling on behalf of the U. S. Department of Energy regarding the Motor Challenge program. I would like to ask you a few questions about your experience with products and services provided to through the Motor Challenge program.

Respondent Characterization

First, I'd like to get some basic information about your company and its activities at this location.

RC1. What is the principal economic activity at this location? [PROMPT IF NECESSARY.]

- Manufacturing 1
- Water, Sewer, Irrigation 2
- Other Industrial (e.g. Mining) 3
- Business services 4
- Education, health, social services 5
- Government services, administration 6
- Other (Specify _____) 7

RC1a Do you use any electrical motors of one horsepower or larger for industrial processes at this location?

- Yes [GO TO RC2.] 1
- No [THANK AND TERMINATE] 2
- Don't know [THANK AND TERMINATE] 3

RC2 What is the principal product produced at this facility?

- Food, beverages, tobacco 1
- Textiles and apparel 2
- Lumber, furniture 3
- Paper and related products 4
- Chemicals and related products 5
- Petroleum products 6
- Plastics and rubber 7
- Stone, clay, glass, concrete 8
- Primary metals (e.g. steel, aluminum) 9
- Fabricated metal products, equipment, machinery 10
- Electronic equipment 11
- Agricultural products 12
- Water, sewer, irrigation services 13
- Mining and minerals 14
- Other (Specify _____) 15

_____

RC2a Do you know the SIC number for this facility? IF YES, What is it?

ENTER SIC CODE, 9999 FOR DON'T KNOW (DK) ..... _____

RC3 How many full-time employees of all types work at this location?

ENTER NUMBER OF FULL TIME EMPLOYEES,00 FOR DK _____

RC4 Is this location the sole production facility for your firm, or is it a subsidiary or branch of a larger company?

Sole production facility 1
Branch 2
Headquarters..... 3

RC5 Roughly, how much did this location spend on electricity last year?

ENTER DOLLAR AMOUNT, 99 FOR DK..... _____

RC6 What is your job title or position? (CHECK ONE ONLY)

Plant Manager 1
Maintenance Manager 2
Purchasing Manager 3
Plant Engineer 4
Chief Electrician..... 5
President, CEO, or general manager 6
Other (Specify _____)..... 7

Motor Challenge

MC1. Are you aware of the Motor Challenge program operated by the U. S. Department of Energy?

Yes [GO TO MC2] 1
No [SKIP TO MC3] 2
Not sure [SKIP TO MC3] 3

MC2. How did your company learn about the Motor Challenge program?

Directly from DOE or a contractor to DOE 1
Supplier/Vendor 2
Engineer/Consultant 3
DOE Publication, *Turning Point, Energy Matters* 4

Industry trade group 5
Industry publication 6
Conference 7
Internet 8
Other_____ 9

MC3 Please tell me if you have used any of the following Motor Challenge materials or services in the course of your work. READ AND MARK ALL MENTIONED

Information Clearinghouse or 800 number 1
MotorMaster+ Software Motor Selection Software 2
Training sponsored or co-sponsored by the Department of Energy in adjustable speed drives, motor selection, or pump efficiency 3
Technical publications distributed by the Motor Challenge Clearinghouse or cooperating organizations 4
Turning Point or *Energy Matters* Newsletter 5
Other materials (Specify _____) 6
None of the above 7

Motor Inventory and Purchases

MI1 About how many electric motors of one horsepower or greater are currently in use in production equipment at this location?

ENTER NUMBER OF MOTORS, 1 FOR DK ..... _____

MI2 And, about how many electric motors of one horsepower or greater did you purchase for this location in the last year, including motors that are part of OEM equipment?

ENTER NUMBER OF MOTORS ..... _____

IF RESPONDENT CANNOT PROVIDE NUMBER MI2 ASK MI2a. ELSE GO TO MI3.

MI2a Then can you tell me about what percentage of the motors currently in use in your facility were purchased last year?

ENTER MOTORS PURCHASED AS % OF MI1 ..... _____

MI3 What percentage of the motors you purchased last year fell into the following three horsepower categories?

a. 1-5 horsepower ..... _____
b. 7.5-20 horsepower ..... _____
c. Over 20 horsepower ..... _____

[SHOULD ADD TO 100.]

MI4 What percentage of these motors was designated as "premium efficient" or "energy efficient" by the motor manufacturer or dealer?

ENTER PERCENTAGE EFFICIENT ..... _____

IF MC3 DOES NOT EQUAL 7 (RESPONDENT REPORTS USING SOME MOTOR CHALLENGE TOOLS OR MATERIALS), ASK MI4.

MI4 Have you used the MotorMaster+ motor selection software or other Motor Challenge tools and materials to help decide which motors to purchase?

Yes 1
No 2
Don't know 3

IF MI4 = 1, ASK MI5, ELSE SKIP TO MI9.

MI5 If you had not been able to use Motor Challenge tools and materials, do you think the percentage of energy efficient or premium efficiency motors you bought last year would have been higher, lower, or about the same?

Higher [ASK Q. MI6] 1
Lower [ASK Q. MI6] 2
About the same [SKIP TO Q. MI7] 3
Don't know [SKIP TO Q. MI7] 4

MI6 How much higher (lower)? INDICATE PERCENTAGE LOWER WITH A MINUS SIGN. ..... _____%

MI7 In what year did you first use Motor Challenge tools and materials to guide motor selection?

ENTER YEAR, ENTER 77 FOR DK..... __ __

MI8. How often do you use Motor Challenge tools and materials in deciding which motors to purchase? Would you say it is....

Every time you purchase a motor over one horsepower 1
Most of the time 2
Half of the time 3
Less than half of the time 4
Hardly ever 5
Don't know 6

MI9 Over the past 3 years, has your company participated in utility-sponsored programs that offered rebates or other incentives for purchasing energy-efficient motors?

Yes [ASK MI10] 1
No [SKIP TO MI11] 2
Don't know [SKIP TO MI11] 3

MI10 Compared to these rebates, would you say that the information and analysis you got from MotorMaster+ or other Motor Challenge materials was more important, less important, or equally important in your decision to purchase energy-efficient or premium motors?

More important 1
Less important 2
Equally important 3
Don't know 4

MI11a What is the most important factor you consider in selecting electric motor models? [MARK ONE ONLY.]

MI11b What other factors are important in this purchase decision? [MARK ALL MENTIONED.]

	MI11a	MI11b
No other factors	n/a	1
The cost of the motor ("capital cost," "first cost")	2	2
Manufacturer; reputation of manufacturer	3	3
Timeliness of availability	4	4
Operating cost of the motor	5	5
Total costs: capital + operating, "life cycle costs"	6	6
Match to end-use requirements	7	7
Special motors needed for our processes	8	8
Quality, reliability of motors	9	9
Other, Specify:	10	10
Don't know	11	11

IF MI11a <u>OR</u> MI11b = 5 OR 6, ASK MI12. ELSE SKIP TO PP1.

MI12 Since your company began using Motor Challenge tools and materials to guide motor purchases, would you say that operating costs have become more important in determining which electric motors to buy, less important, or remained about the same in importance?

More important..... 1
Less important..... 2
Stayed about the same..... 3
Don't know..... 4

Motor Challenge and Purchasing Policy

PP1 Does your company have a policy or procedure to guide the selection of electric motors?

Yes 1
No 2
Don't know 3

IF PP1 = 1, ASK PP2, ELSE SKIP TO RW1.

PP2 Is this policy ....

A formal set of written rules or specifications 1
An informal set of guidelines used by a number of people 2
Your own informal set of guidelines 3
Some combination of the above 4

PP3 Does this policy specify or suggest the efficiency ratings of motors to be purchased?

Yes [GO TO PP3a] 1
No [SKIP TO RW1] 2
Don't know [SKIP TO RW1] 3

PP3a Which of the following best summarizes your motor purchase policy in regard to the energy-efficiency rating of the motors? [MARK ONLY ONE]

Premium efficiency is required for all motors to which efficiency standards apply 1
Premium efficiency is required for some horsepower categories 2
Premium efficiency is required for some motors which meet certain criteria such as operating hours or critical applications 3
Premium efficiency is required if financial criteria such as payback are met 4
None of the above 5

PP4 Did you use MotorMaster+ or other Motor Challenge tools and materials in developing your motor purchase policy?

Yes [ASK Q. PP5.] 1
No [SKIP TO RW1] 2
Don't know [SKIP TO RW1.] 3

PP5 If Motor Challenge tools and materials had not been available do you think you would have developed and adopted a motor purchase policy?

Yes [ASK Q. PP6.] 1
No [SKIP TO RW1.] 2
Don't know [SKIP TO RW1.] 3

PP6 Do you think the efficiency levels specified by this policy would have been as high in the absence of information and analysis provided by Motor Challenge tools and materials?

Yes..... 1
No..... 2
Don’t know..... 3

Rewind Decisions

RW1 How many failed motors did your company rewind last year?
ENTER NUMBER OF MOTORS ..... _____

IF RESPONDENT CANNOT PROVIDE NUMBER RW1 ASK RW1a. ELSE GO TO RW2.

RW1a Then can you tell me about what percentage of the motors currently in use in your facility were purchased last year?
ENTER MOTORS PURCHASED AS % OF MI1 ..... _____

RW2 Last year, what percentage of failed motors did you rewind in the following three horsepower categories?
a. 1-5 horsepower ..... _____
b. 7.5-20 horsepower ..... _____
c. Over 20 horsepower ..... _____
[SHOULD ADD TO 100.]

RW3 Have you used MotorMaster+ or other Motor Challenge materials to support decisions whether to rewind versus replace specific failed motors?
Yes [ASK RW4] 1
No [SKIP TO END] 2
Don't know [SKIP TO END] 3

RW4 If you had not been able to use Motor Challenge tools and materials, do you think the percentage of failed motors you rewound instead of replacing last year would have been higher, lower, or about the same?
Higher [ASK Q. RW5] 1
Lower [ASK Q. RW5] 2
About the same [SKIP TO Q. RW6] 3
Don't know [SKIP TO Q. RW6] 4

RW5 How much higher (lower)? INDICATE PERCENTAGE LOWER WITH A MINUS SIGN. ..... _____%

RW6 In what year did you first use Motor Challenge tools and materials to guide replace versus rewind decisions?
ENTER YEAR, ENTER 77 FOR DK ..... __ __

Motors Training Program
Interview Guide

Name	**Phone**
Title	**Fax**
Company	**e-mail**
Street Address	
City	**Interviewer**
State	**Call dates**
ZIP	**Complete Date**

Lead-in
Hello, my name is _____ and I am calling from Xenergy, Inc. on behalf of the U.S. Department of Energy. We are conducting an evaluation of the DOE's Motor Challenge Program and are contacting participants to get their impressions on the Motor Challenge training programs.

[SCREENING QUESTION]

S.1 Did you attend a Department of Energy Motor Challenge training program?
- Yes 1
- No 2

IF S.1 = 1, THEN PROCEED. IF S.1 = 2, THEN TERMINATE CALL.

I would like to ask you a few questions about your experience with the Motor Challenge _____ training workshop. The whole interview should take about 15 - 20 minutes. Please be assured that the information you provide in the interview will remain confidential with XENERGY/DOE. We will not identify or attribute any of your comments or company information. Do you have time to speak to me now?

First, we would like to get some basic information about you and your firm.

1.1 What kind of business are you?
- a) Motor Distributor 1
- b) Motor Manufacturer 2
- c) Industrial 3
- d) Energy Services 4
- e) Other (Specify) 5

1.2 What is your SIC code?
- ENTER SIC CODE ..... _____

1.3 What type of processes occur in this facility?
- a) Metals fabrication 1
- b) Chemical 2
- c) General Materials 3
- d) Food 4
- e) Metal 5
- f) Textile 6

g) Mining and Mineral.....7
h) Wood, Pulp, and Paper.....8
i) Generic Processes.....9
j) Other (Specify).....10

1.4 Does your company have more than one location?

Yes.....1
No.....2

IF YES, ASK 1.4.a, OTHERWISE SKIP TO 1.5

1.4.a Do you have similar responsibilities at the branch office/offices?

Yes.....1
No.....2

1.5 About how many total workers (full time equivalent) are employed at this location?

ENTER NUMBER OF FTEs....._____

1.6 What is the percentage of motors/motor energy used for pumps, fans, air compressors and other process components?

ENTER PERCENTAGE. ....._____%

1.7 Can you tell me approximately how much electricity is used in this facility each year?

ENTER ELECTRICITY USAGE. ....._____

1.8 And can you tell me approximately how much this facility spends on electricity every year?

ENTER DOLLARS SPENT.....$_____

POSITION

Next, I would like to ask you a few questions about your position at the facility.

2.1 What is your title or position?

a) Plant Manager.....1
b) Maintenance Manager.....2
c) Purchasing Manager.....3
d) Plant Engineer.....4
e) Chief Electrician.....5
f) President or General Manager.....6
g) Other (Specify).....7

2.2 What department are you operating within?

a) Maintenance/Operation.....1
b) Engineering.....2
c) Management.....3
d) Sales/Marketing.....4
e) Research.....5
f) Other (Specify).....6

g) Don't know/Refuse 7

2.3 What are your responsibilities at the facility?

a) Specify motors/motor drivers 1
b) Motor Repair/Replacement Decisions 2
c) Purchase of management of drives, pumps, fans, air compression systems 3
d) Motor Management 4
e) Setting energy efficiency policy 5
f) Processing or manufacturing 6
g) Other (Specify) 7

2.4 How many employees do you oversee?

ENTER NUMBER OF FTEs ..... _____

TRAINING WORKSHOP

Now, I would like to ask you some questions about what you learned at the training program.

3.1 How did you find out about the training program?

a) Motor Challenge Clearinghouse 1
b) DOE Staff Person 2
c) Local Utility 3
d) Co-Worker 4
e) Mail 5
f) Other (Specify) 6
g) Don't Know 7

3.2 Did you apply the skills you learned to your daily activities?

Yes 1
No 2

3.2.a If no, explain.

_____
_____
_____

3.3 What did you learn at the training session?

a) Characteristics of efficient motors 1
b) Potential savings and costs 2
c) How to quantify benefits 3
d) How to use MM+ to identify best motors for replacement and also how to use MM+ to guide replace versus rewind decision.
e) Other (Specify) 4

3.4 Did you use the information to identify candidate systems?

Yes 1
No 2

3.4.a If yes, how many systems?

ENTER NUMBER OF SYSTEMS ..... _____

3.4.b What kinds of systems?

a) Pumps 1
b) Fans 2
c) Air compressor systems 3
d) Other (Specify) 4

3.5 Did you use it to quantify benefits?

Yes 1
No 2

3.6 Did you estimate energy savings?

Yes 1
No 2

IF YES, ASK 3.6.A. OTHERWISE SKIP TO 4.1

3.6.a What was the energy savings estimate?

ENERGY SAVINGS ESTIMATE ..... _____

MOTOR-RELATED DECISIONS

4.1 Did the program help guide your selection of motors?

Yes 1
No 2

4.2 Did you purchase more energy efficient motors?

Yes 1
No 2

IF YES, GO TO 4.3. OTHERWISE SKIP TO 4.4

4.3 How many did you purchase?

_____1-20 HP _____21-100 HP _____Over 100 HP

4.4 Did you adopt a policy to only buy efficient motors?

Yes 1
No 2

4.5 Did you use the information to guide rewind versus replace decisions?

Yes 1
No 2

IF YES ASK 4.6. OTHERWISE SKIP TO 5.1

4.6 Approximately how many motors of one horsepower or more are purchased in a year?

_____1-20 HP _____21-100 HP _____Over 100 HP

OTHER PROJECTS

5.1 Are you planning similar projects in this or other facilities?

Yes.....1
No.....2

5.2.a If yes, when do you plan to do it?

ENTER DATE....._____

5.3 What is the size of the project? Will it be.....

a) Same size.....1
b) Larger.....2
c) Smaller.....3
d) Other (Specify).....4

Finally, I would like to ask you a few questions about your views on the Motor Challenge Program.

6.1 What did you like about the training program?

_____
_____
_____

6.2 Did you know about these cost-saving and energy efficiency methods prior to attending the training program?

Yes.....1
No.....2

6.3 Would you have implemented changes to your system regardless of the training program?

Yes.....1
No.....2

6.3.a Why/why not?

_____
_____
_____

6.4 Finally, how do you think the training program could be improved?

_____
_____
_____

RW7. How often do you use Motor Challenge tools and materials in deciding which to rewind versus replace? Would you say it is....

Every time you purchase a motor over one horsepower 1
Most of the time 2
Half of the time 3
Less than half of the time 4
Hardly ever 5
Don't know 6

RW8 Prior to using MotorMaster+ to support rewind decisions, did you apply financial analyses that took operating costs into account when deciding which motors to rewind?

Yes 1
No 2
Don't know 3

THANK YOU FOR YOUR TIME AND YOUR HELP.

Pumps Training Program
Interview Guide

Name	**Phone**
Title	**Fax**
Company	**e-mail**
Street Address	
City	**Interviewer**
State	**Call dates**
ZIP	**Complete Date**

Lead-in
Hello, my name is _____ and I am calling from Xenergy, Inc. on behalf of the U.S. Department of Energy. We are conducting an evaluation of the DOE's Motor Challenge Program and are contacting participants to get their impressions on the Motor Challenge training programs.

[SCREENING QUESTION]

S.1 Did you attend a Department of Energy Motor Challenge training program?
- Yes 1
- No 2

IF S.1 = 1, THEN PROCEED. IF S.1 = 2, THEN TERMINATE CALL.

I would like to ask you a few questions about your experience with the Motor Challenge _____ training workshop. The whole interview should take about 15 - 20 minutes. Please be assured that the information you provide in the interview will remain confidential with XENERGY/DOE. We will not identify or attribute any of your comments or company information. Do you have time to speak to me now?

First, we would like to get some basic information about you and your firm.

1.1 What kind of business are you?
- a) Motor Distributor 1
- b) Motor Manufacturer 2
- c) Industrial 3
- d) Energy Services 4
- e) Other (Specify) 5

1.2 What is your SIC code?
- ENTER SIC CODE ..... _____

1.3 What type of processes occur in this facility?
- a) Metals fabrication 1
- b) Chemical 2
- c) General Materials 3
- d) Food 4
- e) Metal 5
- f) Textile 6

g) Mining and Mineral.....7
h) Wood, Pulp, and Paper.....8
i) Generic Processes.....9
j) Other (Specify).....10

1.4 Does your company have more than one location?
Yes.....1
No.....2

IF YES, ASK 1.4.a, OTHERWISE SKIP TO 1.5

1.4.a Do you have similar responsibilities at the branch office/offices?
Yes.....1
No.....2

1.5 About how many total workers (full time equivalent) are employed at this location?
ENTER NUMBER OF FTEs....._____

1.6 What is the percentage of motor/motor energy used for pumps, fans, air compressors and other process components?
ENTER PERCENTAGE. ....._____%

1.7 Can you tell me approximately how much electricity is used in this facility each year?
ENTER ELECTRICITY USAGE. ....._____

1.8 And can you tell me approximately how much this facility spends on electricity every year?
ENTER DOLLARS SPENT.....$_____

POSITION

Next, I would like to ask you a few questions about your position at the facility.

2.1 What is your title or position?
a) Plant Manager.....1
b) Maintenance Manager.....2
c) Purchasing Manager.....3
d) Plant Engineer.....4
e) Chief Electrician.....5
f) President or General Manager.....6
g) Other (Specify).....7

2.2 What department are you operating within?
a) Maintenance/Operation.....1
b) Engineering.....2
c) Management.....3
d) Sales/Marketing.....4
e) Research.....5
f) Other (Specify).....6

g) Don't know/Refuse 7

2.3 What are your responsibilities at the facility?

a) Specify motors/motor drivers 1
b) Motor Repair/Replacement Decisions 2
c) Purchase of management of drives, pumps, fans, air compression systems 3
d) Motor Management 4
e) Setting energy efficiency policy 5
f) Processing or manufacturing 6
g) Other (Specify) 7

2.4 How many employees do you oversee?

ENTER NUMBER OF FTEs ..... _____

TRAINING WORKSHOP

Now, I would like to ask you some questions about what you learned at the training program.

3.1 How did you find out about the training program?

a) Motor Challenge Clearinghouse 1
b) DOE Staff Person 2
c) Local Utility 3
d) Co-Worker 4
e) Mail 5
f) Other (Specify) 6
g) Don't Know 7

3.2 Did you apply the skills you learned at the training program to your daily activities?

Yes 1
No 2

If no, explain.

_____
_____
_____

3.3 What did you learn at the training session?

a) Potential savings and costs 1
b) How to identify candidate systems 2
c) How to quantify potential benefits 3
d) Other (Specify) 4

3.4 Did you use the information to identify candidate systems?

Yes 1
No 2

IF YES, ASK 3.4.A, OTHERWISE GO TO 3.5

3.4.a If yes, how many systems?

ENTER NUMBER OF SYSTEMS ..... _____

3.4.b What kinds of systems?

a) Pumps 1
b) Fans 2
c) Air compressor systems 3
d) Other (Specify) 4

3.5 Did you use it to quantify benefits?

Yes 1
No 2

3.6 Did you use the information to adopt a policy on more efficient pumps?

Yes 1
No 2

3.7 Did you purchase more energy efficient motors?

Yes 1
No 2

IF YES, ASK 3.7.a. OTHERWISE SKIP TO 3.8

3.7.a. How many motors were purchased?

_____1-20 HP _____21-100 HP _____Over 100 HP

3.8 Did you estimate energy savings?

Yes 1
No 2

IF YES, ASK 3.8.A. OTHERWISE SKIP TO 4.1

3.8.a What was the energy savings estimate?

ENERGY SAVINGS ESTIMATE ..... _____

OTHER PROJECTS

4.1 Are you planning similar projects in this or other facilities?

Yes 1
No 2

4.1.a If yes, when do you plan to do it?

ENTER DATE ..... _____

4.2 What is the size of the project? Will it be.....

a) Same size.....1
b) Larger.....2
c) Smaller.....3
d) Other (Specify).....4

Finally, I would like to ask you a few questions about your views on the Motor Challenge Program.

5.1 What did you like about the training program?

_____
_____
_____

5.3 Did you know about these cost-saving and energy efficiency methods prior to attending the training program.

Yes.....1
No.....2

5.3 Would you have implemented changes to your system regardless of the training program?

Yes.....1
No.....2

5.3.a Why/why not?

_____
_____
_____

5.4 Finally, how do you think the training program could be improved?

_____
_____
_____

THANK YOU FOR YOUR TIME AND ASSISTANCE.

ASD Training Program
Interview Guide

Name	**Phone**
Title	**Fax**
Company	**e-mail**
Street Address	
City	**Interviewer**
State	**Call dates**
ZIP	**Complete Date**

Introduction: Hello, my name is _____ with XENERGY Consulting. I am calling on behalf of the U.S. Department of Energy regarding the Motor Challenge program. We are conducting an evaluation of the program and are contacting participants to ask some questions regarding their experience with the Motor Challenge "Adjustable Speed Drive Application" training workshop. The whole interview should take about 15 - 20 minutes. Is it a convenient time to speak now or can we schedule a time to speak?

First, I would like to get some basic information about you and your company.

Respondent Characterization

RC1 What is your title?

a) Plant Manager 1
b) Purchasing Manager 2
c) Plant Engineer 3
d) Sales Associate 4
e) Consulting Engineer 5
f) Other (Specify) 6

RC2 What department are you in?

a) Maintenance/Operation 1
b) Engineering 2
c) Management 3
d) Sales/Marketing 4
e) Research 5
f) Other (Specify) 6

RC3 Could you describe your job responsibilities? PROBE RESPONDENT'S ROLE IN SPECIFYING, PURCHASING, INSTALLING, MAINTAINING, OR SELLING MOTOR-DRIVEN EQUIPMENT.

_____

RC4 If the company has multiple sites, do you perform these duties at other locations as well? _____

Customer Characterization

CC1 What type of business is your company involved in?

a) Manufacturer 1
b) Utility 2
c) Government facility..... 3
d) Equipment vendor 4
e) Energy Services..... 5
f) Consulting 6
g) Other (Specify)..... .7

If CC1 = 1, then continue. Otherwise, skip to VC1.

CC2 What type of product is your facility involved with?

_____

CC3 What is the SIC code for your facility?

_____

CC4 How many full-time employees work at your facility?

_____

CC5 Can you give me the approximate number of motors with HP>1 used in production at your facility?

_____

Prior Experience

PE1 Were you aware of adjustable speed drive technology prior to the training workshop?

a) Yes..... 1
b) No..... 2

If YES, continue. Otherwise skip to RT1.

PE2 Have you ever used adjustable speed drives in your facility before?

a) Yes..... 1
b) No..... 2

If YES, continue. Otherwise, skip to PE10

PE3 Can you describe the specific projects and applications involving ASDs you were involved in?

_____

_____

_____

_____

PE4 How many projects did you undertake in the last two years?

_____

PE5 How many dollars were spent on these projects?

_____

PE6 Were you satisfied with the results of the project?. If YES, continue. If NO, skip to PE9.

a) Yes..... 1
b) No..... 2

PE7 What factors contributed to your satisfaction?

a) Level of energy savings..... 1
b) Level of maintenance 2
c) Process improvements..... 3
d) Improved product quality..... 4
e) Project economics 5
f) Other (Specify)..... .6

PE8 What factors contributed to your lack of satisfaction?

a) Project costs..... 1
b) System performance..... 2
c) Other (Specify)..... .3

PE9 What factors contributed to the fact that you did not use ASD technology?

a) Costs..... 1
b) Doubts about system performance 2
c) Lack of technical knowledge..... 3
d) Other (Specify)..... .4

PE10 At the time you learned about the training, were you planning to implement an ASD project? If YES, what type of application were you planning?

a) Yes..... 1
b) No..... 2

Response to Training

RT1 How did you find out about the training?

a) Motor Challenge Clearinghouse 1
b) DOE Staff Person 2
c) Local Utility 3
d) Industry Trade Group 4
e) Industry Publication 5
f) Consultant/Engineer 6
g) Other (Specify) 7
h) Don't Know 8

Application of Training

AT1 Since the training, have you engaged in any projects or procedures?

a) Yes 1
b) No 2

If YES, continue. Otherwise skip to AT13.

AT2 How many projects have you worked on?

_____

AT3 Can you describe the type of system(s) involved in the project? PROBE FOR SPECIFIC APPLICATIONS AND PROCESSES.

_____
_____
_____
_____

AT4 How many systems were involved?

_____

AT5 What was the HP of the systems involved?

_____

AT6 What specific improvements were made?

_____
_____
_____
_____

AT7 What was the cost of the improvements?

_____

AT8 What are the savings or anticipated savings based on the improvements?

_____

AT9 Can you describe how the training experience facilitated the implementation of the projects?

_____

_____

AT10 How likely is it that these improvements would have been made in the absence of the resources and knowledge you gained through the training?

a) Very likely..... 1
b) Somewhat likely..... 2
c) Not likely at all.....

AT11 (If did projects prior to the training) Based on the training experience, did you use VFDs in any different types of applications or on any different size motors than you had previously?

a) Applied to more/different motor sizes..... 1
b) Applied to more/different applications..... 2

AT12 Are you planning any additional projects in the next year?

a) Yes..... 1
b) No..... 2

If YES, repeat AT3-AT10. If NO, why not?

_____

AT13 What were your reasons for not initiating any projects as a result of the training?

a) Budget issues..... 1
b) Benefits not perceived as great enough..... 2
c) Need for corporate approval..... 3
d) Systems not appropriate for site..... 4
e) Other (Specify)..... 5

Vendor Characterization

VC1 What type of service(s) does your firm provide?

a) Equipment vendor..... 1
b) Energy Services..... 2
c) Consulting 3
d) Other (Specify)..... 4

VC2 What are your primary markets? Specify type and size.

_____

VC3 How many full-time employees work at your location?

_____

VC4 What were your firms annual revenues in 1998?

_____

Prior Experience

VE1 Prior to the training, how much experience did you have with the design, specification, or sale of ASD technology?

_____

VE2 In what percentage of relevant cases did you specify or sell ASD technology?

_____

Response to Training

VR1 How did you find out about the training?

a) Motor Challenge Clearinghouse..... 1
b) DOE Staff Person..... 2
c) Local Utility 3
d) Industry Trade Group..... 4
e) Industry Publication 5
f) Consultant/Engineer..... 6
g) Other (Specify)..... .7
h) Don't Know..... 8

Application of Training

VT1 Since the training, have you applied any of what you learned to projects for clients or equipment sales?

_____

If YES, continue. Otherwise, skip to VT12

VT2 Did your criteria for recommending ASDs change as a result of the training?

VT3 Do you recommend ASDs:

a) More often..... 1
b) The same..... 2
c) Less often..... 3

VT4 In how many instances did you specify or sell ASD technology?

_____

VT5 Can you describe the type of system(s) involved in the project your client(s) were undertaking? PROBE FOR SPECIFIC APPLICATIONS AND PROCESSES.

VT6 How many systems were involved?

_____

VT7 What was the HP of the systems involved?

_____

VT8 What are the savings or anticipated savings based on the specifications/sales?

_____

VT9 How likely is it that these specifications/sales would have been made in the absence of the resources and knowledge you gained through the training?

a) Very likely..... 1
b) Somewhat likely..... 2
c) Not likely at all..... 3

VT10 Do you plan to continue using these practices in future specifications/sales? If NO, why not?

a) Yes..... 1
b) No..... 2

VT11 Can you describe how the training experience facilitated your specification/sale of ASD technology? Specify examples.

_____

_____

VT12 What were your reasons for not applying the knowledge/experience gained on ASDs?

a) Systems not appropriate for sites..... 1
b) Cost 2
c) Doubts about performance 3
d) Lack of customer interest 4
e) Other (Specify)..... 5

VT13 How important is the capability to offer ASD technology to your overall business?

a) Very important..... 1
b) Somewhat important..... 2
c) Not important at all..... 3

THANK YOU FOR YOUR TIME AND ASSISTANCE.